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THE REDUCTION OF OLD OR IRREDUCIBLE DISLOCATIONS OF THE SHOULDER JOINT

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SINCE they were first described in the early works on surgery, old and irreducible dislocations of the shoulder joint have been a very difficult problem for surgeons. Improvement in the methods of treatment of these conditions has been very slow for the reason that the injury most commonly occurs in the laboring class and in the ignorant patients who are less likely to have competent surgical help.

It is difficult to understand how a condition so clear cut and with such outstanding symptoms can be overlooked and remain undiagnosed until the condition has become ancient. We will admit that the symptoms may be obscure if the patient is obese, in which case diagnosis is dependent entirely upon the physical findings; sometimes even in this type of case a poor roentgenogram, taken in an incorrect position, may be very misleading. On the whole, however, diagnosis should be rapidly and accurately made and the proper reduction accomplished.

That there are dislocations of the shoulder which cannot be reduced by any manipulative measure is a factor always disputed by the surgeon with an experience limited to 50 to 100 cases. When, however, the surgeon has treated 100 or more patients, he is as a rule ready to admit that there are times when it not only is not possible to reduce the dislocation, but that it is an extremely dangerous step to proceed with the manipulative treatment.

The old literature is filled with reports of rupture of the axillary vessels and injuries to the nerves of the shoulder, arm, and forearm, as well as fractures of the humeral head which later have had to be removed by an open operation. The literature of the days before, and to some extent after, the advent of aseptic precautions is also filled with the reports of victories over neglected dislocations, by means of manipulative measures, but by and all the surgeon who causes a serious injury in a surgical attempt does not display his error in headlines. We are convinced that a careful open operation is much safer and will produce a higher percentage of good results than can be obtained by manipulative measures, which must be done, as it were, in the dark.

After teaching with cadaveric material the causes of production and the means of reduction of dislocations of the shoulder, one of us was very confident that a manipulative reduction could always be accomplished with safety. A wide clinical experience gained in many years has convinced him, however, that such is not the case. We are, therefore, ready to state unequivocally that some relatively recent dislocations cannot be reduced by manipulative measures, for there is always the great danger

that the function of the arm may be impaired by such measures.

In manipulative procedures no holds or methods are barred, provided they are not harmful. We have used Kocher's method, the traction method, the hammock method, and once or twice, in spite of our fear and abhorrence, have put a heel in the axilla. We believe that, of all these measures, traction of a firm, steady type, with the surgeon manipulating while the assistant making the traction varies the line of pull or rotates the limb, is by far the safest and most satisfactory method. Many dislocations have been reduced by the Kocher method with speed and safety, but there are times when it is not effective. The hammock or suspension method will also fail far more frequently than the steady traction and manipulation.

But this is not a paper designed to deal with manipulative methods—rather it is one desired to describe what we consider to be the safest and most satisfactory method of reducing an old or irreducible dislocation by open operation. As nearly as we have been able to determine, and it is far from simple in the bottom of a large oozing wound, these dislocations are caused first and most commonly by the firm hold of the long head of the biceps. It does not seem to occupy any very unusual position and in only two cases have we seen it torn from its groove in the humerus; never have we seen it torn from the glenoid or ruptured. The head of the biceps simply holds the humeral head firmly until the former has been freed from its groove, or slipped forward over the humeral head when out of the groove. But when the head of the biceps is released, the humeral head as a rule can be freed immediately. In the cadaver, we have found that difficult cases for reduction could be produced by cutting a longitudinal slit in the capsule, inferior and slightly anterior, then forcing the humeral head down through the slit without causing a wide tear in the capsule. This narrow slit will sometimes hold so firmly that it will require 15 to 20 minutes of expert manipulation before the head can be reduced. But we have not seen, or, better say, have not been able to identify, any case of this type in our operative cases. The reason for this may be that we have made a reduction in the greater number of our cases by the anterior approach, which at best gives a very limited view of the injured tissues.

In contrast to the cases which we described as being made with a slit in the lower anterior surface of the capsule, we felt reasonably certain that reduction could be easily accomplished in those cases in which great violence had been exerted at the time of the injury and in which the force had continued after the production of the injury so that there had been extensive tendon and muscle destruction. In the vast majority of cases this continues to hold true, but in one of our recent cases the patient was operated upon by this new method for a recent dislocation. Great force was one of the causes of the injury and the man had had four different manipulative attempts at reduction under complete anæsthesia before open operation was decided upon. In this man's shoulder nearly every ligament had been destroyed except the long head of the biceps and the subscapularis tendon, yet reduction could not be accomplished until the biceps tendon had been freed from its groove and slipped forward over the head.

Some of our favorite theories consequently began to fade: for example, a dislocation, in which the violence producing the injury is of only brief duration not having continued long enough to cause the limb to be violently twisted around after the infliction of the initial insult, is as a rule difficult to reduce; on the other hand, a dislocation in which there has been long continued and violent injury, with a maximum destruction of the adjacent tissues, is, as a rule, easily reduced. We expect that these statements will be criticized, but after all they are based on our observations. We have not used the operation of E. Wyllys Andrews, although we admit that it gives a very excellent exposure. The objections to it are: (1) that it makes a very unsightly scar; (2) that the tendon of the pectoralis major is not easily handled and it may not hold firmly when sutured; (3) that the arm must be dressed at the side and, therefore, in an elderly person the shoulder is very difficult or impossible to mobilize after a long period of immobilization. Moreover, it would be just as

difficult with this approach to force the head into the glenoid cavity without that cavity having been freed of this condition. We have always adhered to the belief that the less trauma connected with a procedure the more nearly perfect will the recovery be; hence we have hesitated to cut the subscapularis tendon, after the method of Dollinger, and especially as it has been so easy to mobilize the long head of the biceps.

The so called "saber cut incision," by which the acromion is cut off, was abandoned, because we wished to preserve the acromion particularly in those cases in which it was advisable to fasten the head of the humerus firmly to it in an abducted position with a strip from the capsule, or with the long tendon of the biceps.

In recent irreducible dislocations in relatively young patients, the old incision along the anterior edge of the deltoid may be used, and the head reduced and dressed to the side. This technique has given excellent results, but even in these young people when this incision is used, the possibility of a recurrent dislocation or of serious injury to the vessels and nerves must be kept in mind. In older patients, however, we are certain that the procedure to be described will be preferable, in that it will avoid a long period of disability, decrease the possibility of recurrence, and give a perfectly functioning shoulder joint. The conditions encountered in old dislocations are vastly different from those in recent dislocations and we shall try to describe and illustrate the pathological condition found. The upper capsule is, as a rule, thickened (Fig. 4). This capsule, combined with the widespread, sheetlike tendons of the supraspinatous and infraspinatous muscles, is in some cases about 5/8 inch thick. This heavy, thick mass begins with the coracohumeral ligament which constitutes the anterior portion, and becomes thicker through the area covered by the supraspinatous and infraspinatous and teres minor tendons. Although the posterior portion of the true capsule is somewhat thinner, still it is about three times its normal thickness. This mass of tendinous tissue described may not be present in all cases, because the tendons may have been

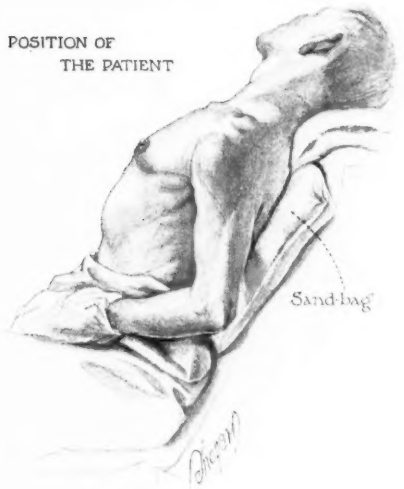

Fig. 1. Position on table with sand bag behind and a little below shoulder.

ruptured at the time of dislocation and have retracted beneath the acromion process; or the greater tuberosity may be avulsed and lie over the dislocated head. We have not found the fractured dislocated tuberosity retracted to any great extent; it is nearly always adjacent to the spot from which it has been torn. This is particularly true if the dislocation in which the avulsion occurred has been reduced without unnecessary delay. We have seen detached fragments dislocated up between the humeral head and the glenoid.

The glenoid cavity is narrow and, if the dislocation is relatively recent, is filled with a gelatinous material. In older cases this changes to a heavy fibrous tissue that tends to obliterate the cavity of the joint completely (Fig. 4). The deltoid muscle is also shortened and shrunken, and the cavity it covers is so narrowed that if the capsule, in its thickened and contracted condition, did not block the reduction of the humeral head, the shrunken deltoid could very easily prevent reduction in old cases.

In operating with the incision extending from the clavicle down to the anterior border of the deltoid, we have been forced by these

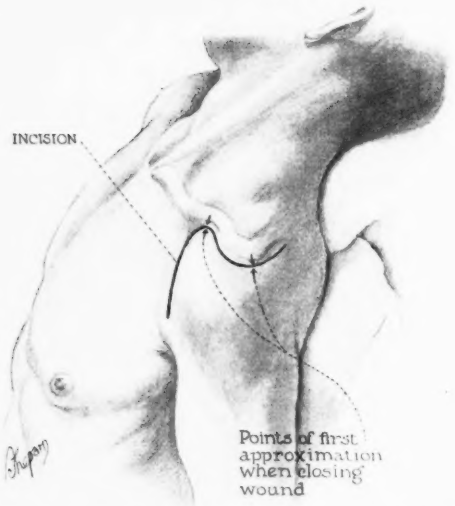

Fig. 2. Incision is made between anteromedial border of the deltoid, and the pectoralis major, anterior and medial to dislocated head of the humerus, is extended up to the middle of the clavicle, then around the clavicle, acromion, and 2 inches on the spine of the scapula. Slight cross incisions are made at arrow points to aid correct reapproximation of deltoid.

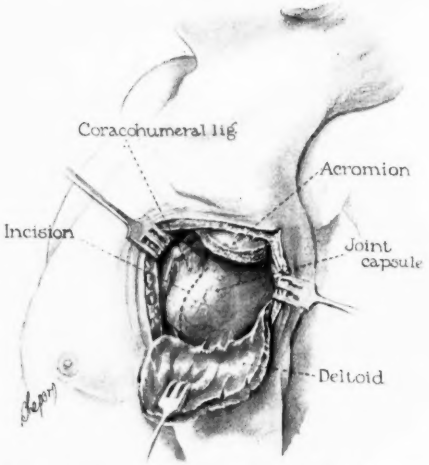

Fig. 3. Deltoid and skin flap reflected down to expose empty glenoid, flattened capsule, and coracoid process with muscular and tendinous attachments.

conditions present in the glenoid cavity in addition to the shortening and shrinkage of the deltoid, to cut away the posterior portion of the capsule and also to free the attachment of the deltoid from the clavicle, acromion, and some of the spine of the scapula, before we were able to reduce the head into its normal position. After the head has been reduced, in order to keep it in the cavity, we have been forced to hold the arm to the side, with the elbow somewhat forward—a step we believe to be preferable to resection of the head of the humerus. We have come to believe, however, that because, following this procedure, the function of the shoulder joint is extremely limited, it would be better to resect the head as has been done by surgeons in this type of case for many years.

It was to overcome these difficulties that we were forced to seek a different method of approach. The method upon which we decided enables us to free the humeral head from its abnormal position with both speed and safety; at no time are we in any danger of injuring the vessels or nerves in any manner, no matter how much time has elapsed since the dislocation was produced. And, most important, we are able to fix the head firmly so that the extremity may be immobilized in the position of salute and at the same time be useful even if ankylosis should occur. We believe also that, with this method of procedure—the freeing of the head, the cleaning out of the glenoid and cavity, the fixing of the head to the acromion with a string strip of fascia lata after the method of Henderson—in a dislocation so old that a new glenoid cavity has formed and there is marked loss of function because of pain from pressure and limitation of motion, a better and more useful joint can be obtained. As the glenoid is easily accessible in this approach, we would suggest that it might be possible to do some plastic work on the glenoid if it has been too much distorted by the misplaced head. But it must be remembered that any fixation of the humeral head with the biceps tendon a part of the capsule, or by the method of Henderson, will limit the rotation of the humeral head, the degree of rotation depending on the individual.

We have found that if the patient is placed in a sitting position (Fig. 1) the surgeon's

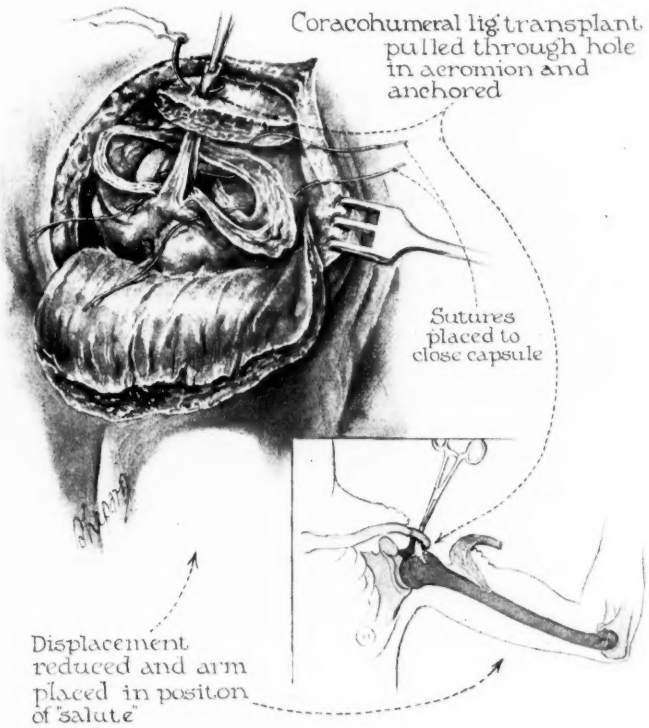
Coracohumeral lig transplant pulled through hole in acromion and anchored
Sutures placed to close capsule
Displacement reduced and arm placed in positon of "salute"

Fig. 5. The coracohumeral ligament is pulled through the drill hole in the acromion for humeral fixation after reduction. Insert shows the position in which the humerus is dressed. The cut edges of the capsule are approximated with catgut sutures.

task becomes less arduous. The anæsthetist is then out of the way and there is good visibility until it is time to close the wound. The fact that the patient's arm is held in the position of salute does make the closure difficult; but closure is even more difficult with the patient reclining. We, therefore, finish the operation with the patient still in the sitting position.

The skin incision (Fig. 2) begins medial to the dislocated head, extends along the anterior border of the deltoid, and is carried up to the clavicle, then along the anterior edge of the clavicle, around the acromion, and back 2 inches along the edge of the scapular spine. Two cross marks are made at the anterior angle and at the posterior angle of the acromion to aid in the correct reapproximation of the deltoid muscle. The incision is then deepened in front down between the anterior edge of the deltoid and upper border of the pec-

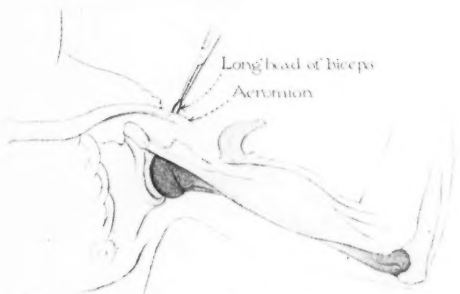

Fig. 6. The position of arm with the humerus fixed in glenoid cavity, the long head of biceps being drawn through and attached to the acromion.

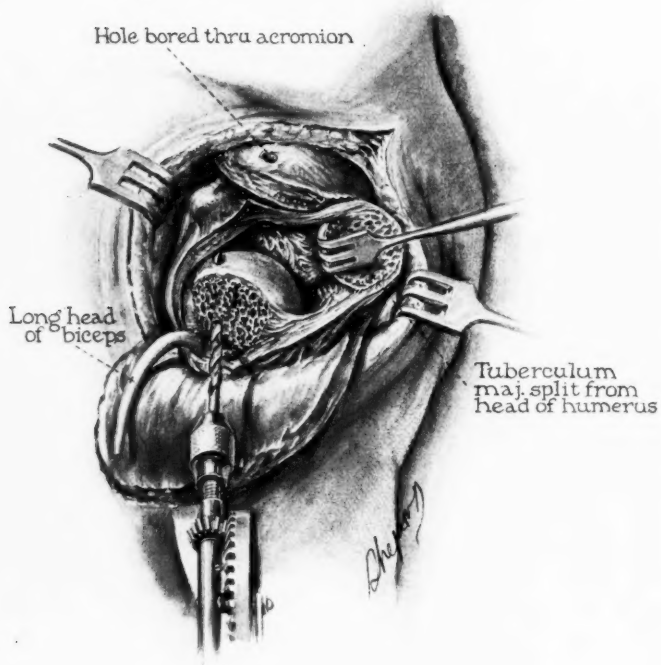

Fig. 7. Exposure of the joint cavity by cutting off the tuberosity major and reflecting it and the capsule. Here the tendon of the biceps is used in the acromion and the tuberosity is sutured down over the tendon with catgut. The fibrous tissue that has formed in the glenoid cavity is shown.

toralis major, until the loose tissues are exposed. The deltoid is cut through at its origin, which is semi-fibrous, to the clavicle and the acromion and spine of the scapula, and the entire mass is reflected downward (Fig. 3). An excellent exposure is thus obtained of the empty glenoid cavity with the capsule and tendons of the supraspinatous, infraspinatous, and the teres minor. In some cases, the tendon of the biceps can also be seen.

At this stage of the operation, we usually make another attempt to reduce the head, and if we are not successful, we make an incision through the capsule along the course of the biceps tendon, freeing it also from its groove between the tuberosities. We might add that while, at this point in the operation, we have found it possible in all of our cases to free the dislocated head, we have not succeeded in returning the head to the glenoid cavity until the capsule is opened. Two methods have been used to accomplish this. In the first, we cut the capsule and accompanying tendons from the major tuberosity well down on the posterior surface of the humerus and retract the capsule with sharp hooks until the joint cavity can be freed of the fibrous tissue (Fig. 4, frontispiece), which may be so dense as almost to obliterate the space. The head is then reduced and the capsule with its tendons is sutured back to the tuberosity with a few fine catgut stitches to hold it in position. A heavy spearpoint needle can usually be driven through the capsule and that portion

of the tendon that remains on the tuberosity, or even through the soft tuberosity itself. If the needle cannot be driven through the tuberosity, one or two small drill holes will give sufficient purchase to hold this tendon in place.

In the second method, we cut off the major tuberosity with a chisel and reflect the entire mass (Fig. 7). While we have not as yet had a great number of cases in which this method has been used and are therefore not yet prepared to say which is the better procedure, we do believe that to incise the capsule transversely about ¼ inch from the major tuberosity will, on the whole, be more satisfactory. We had one case, however, that was difficult to suture correctly.

The question of fixation must be considered before the capsule is closed. Up to the present time we have used the method of Nicola twice; that is, we have cut the long head of the biceps well down toward the muscle belly and have drawn the proximal part through a hole drilled in the tuberosity along the outer edge of the head. The humeral head was then fixed to the acromion with firm catgut stitches placed through the capsule or through the bone.

In 1 case we fixed the humeral head by drawing the long head of the biceps through a tunnel in the humeral head and up through the acromion process (Fig. 7). In one instance we attempted to take a slip of the coracohumeral ligament and pass it through the acromion, but through an error we were forced to use the biceps tendon (Fig. 7). We are convinced, however, that this slip of the coracohumeral ligament can be used and that if correctly inserted will be successful. There is no question that the method of Henderson can be safely used and that it will certainly give a very stable support. We have been a little reluctant to make a second incision if it could be avoided. If one does wish to use the Henderson technique we would suggest that a good plan would be to free the fascial strip first and allow it to remain in its normal bed until the shoulder wound is ready for its use. If this is done the time necessary to keep the major wound open is shortened.

As previously mentioned, before the skin is incised, small transverse lines are made at two points in the curve so that the muscle and skin may be accurately approximated. If these points are now located and the anterior portion of the deltoid is sutured to the cervical fascia at the first point, and the posterior portion at the second corresponding mark, the muscle will fit nicely in place. With three additional sutures that will merely approximate the wound edges—it is not necessary to try to sew the edges together—time can be saved and an excellent union of the muscle obtained. We use silk and skin clips to approximate the skin edges but the operator may prefer some other method.

The arm is dressed in the position of salute and is held in position in a cast, for 4 to 6 weeks. When the cast is first removed, it should be taken off carefully so that after passive and active motion it can be replaced and worn until the patient becomes accustomed to motion and is able to hold the arm in the normal position. As a rule, these first motions have been very painful.

SUMMARY

1. An incision that separates the deltoid from its origin and allows it to be displaced downward, makes possible a safe approach to practically any shoulder joint condition.

2. The incision described is preferable to the saber cut incision which separates the acromion from its attachment, for it saves the acromion which can be used to retain the humeral head in position.

3. The incision gives better access, and a more serviceable joint than the Andrews incision which divides the pectoralis major tendon.

4. If the deltoid is accurately approximated, as described, its function will not be disturbed in the least.

5. The scar causes very little, if any, disfigurement.

EXPERIMENTAL STUDY OF THE EFFECT OF HISTAMINE ON THE HEALING OF GASTRIC DEFECTS—ARTIFICIAL GASTRIC ULCER

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THE cause of the chronicity of peptic ulcer in man is still problematic. Many experimental methods have been devised for producing acute gastric ulcers in animals, but comparatively few ways are available for rendering an acute ulcer chronic.

A number of workers have attempted to prevent the healing of experimental ulcers by the introduction of hydrochloric acid through a stomach tube. Matthes found that 350 cubic centimeters of 0.56 per cent hydrochloric acid introduced daily into a dog's stomach delayed the healing of an artificial defect in the mucosa as compared with a control dog. The same procedure was repeated by Littauer who used 0.37 per cent hydrochloric acid. He also ligated some of the vessels supplying the area in the stomach where the defect was made. One of 5 animals showed a delay in healing when sacrificed after a period of several weeks. Previously, Fibich had reported that ligation of some of the gastric vessels and removal of the corresponding mucosa resulted in gastric ulcer. Littauer was unable to confirm this finding.

Marked anæmia has been found to cause some delay in the healing of experimental ulcers. Quincke and Daetwyler destroyed areas of gastric mucosa of the dog's stomach by various means and noted that these areas healed more slowly if the animals were made anæmic by venesection. The same type of experiment was repeated and confirmed by Silbermann who used subcutaneous injections of pyrogallic acid in place of venesection to produce the anæmia.

The injection of peptone intravenously and subcutaneously was reported by Turck to cause delayed healing of ulcers in 2 of 6 dogs. This has not been confirmed. A possible histamine-like effect of the peptone is of interest in connection with the present study.

Friedman and Hamburger studied the influence of pyloric stenosis, produced by partial constriction of the pylorus with a ligature, on the healing of artificial gastric defects. The stomach became enormously dilated as a result of this procedure and the defects remained unhealed from 4 to 9½ weeks. They attributed the delay in healing to hyperacidity and fermentation. Bolton was also able to delay the healing of ulcers produced with gastrotoxic sera by the same type of procedure.

The ability of a foreign body to interfere with the healing of gastric ulcer was shown by Dragstedt and Vaughan. By cauterizing the stomach with silver nitrate and introducing non-absorbable suture material into the damaged area, they were able to keep ulcers open for 3 to 4 months.

Askanazy has championed the Oidium albicans often found in the base of human peptic ulcers as the cause of the latter. He introduced cultures of this fungus into the stomachs of guinea pigs and rabbits in which artificial defects had been produced and obtained chronic ulcers of several months' duration in some animals. However, Kirch and Stahnke were unsuccessful in delaying the healing of lesions in the dog's stomach by covering them with pure cultures of Oidium albicans.

Morton, utilizing the technique of Mann for "surgical duodenal drainage," studied the effect of preventing duodenal reflux in this manner on the healing of artificial gastric defects. He obtained ulcers which were chronic in appearance and remained open for as long as 3 months. The ulcers which were placed high in the fundus healed more readily than those near the pylorus.

Balint and Weiss offered the hypothesis that chronic ulceration in various parts of the body is due to low grade acidosis. They found that the intravenous administration of sodium acid phosphate, daily, tended to prevent the healing of mucosal defects in the dog's stomach

and they attributed this result to changes in the hydrogen-ion concentration of the blood. Their results have not been confirmed.

Recently interest has been aroused in the action of histamine in delaying the healing of experimental lesions of the stomach. McIlroy cauterized the wall of the cat's stomach and then administered 10 to 20 milligrams of histamine subcutaneously every other day. At the end of 8 to 15 days, there was an extension of the original lesion. O'Shaughnessy obtained chronic looking ulcers in two of a series of cats by injecting the drug locally into the wall of the stomach and subsequently giving very large doses subcutaneously. Friedenwald, Feldman, and Morrison injected 1 per cent hydrochloric acid into the stomach wall and then gave 0.5 milligram of histamine one to three times a day. They concluded that the histamine as given had no effect on healing.

CHIEF METHODS FOR DELAYING HEALING OF MUCOSAL DEFECTS IN STOMACH

Method	Author	Year	Animal used
0.56% HCl by stomach tube	Matthes	1893	Dog
0.37% HCl by stomach tube	Littauer	1909	Dog
Anæmia produced by venesection	Quincke & Daetwyler	1882	Dog
Anæmia produced with pyrogallic acid	Silbermann	1886	Dog
Injections of peptone	Turck	1906	Dog
Partial pyloric stenosis	Friedman & Hamburger	1914	Dog
Non-absorbable suture in floor of defect	Dragstedt & Vaughan	1924	Dog
"Surgical duodenal drainage"	Morton	1927	Dog
Oidium albicans	Askanazy	1924	Rabbit Guinea pig
Sodium acid phosphate intravenously	Balint & Weiss	1927	Dog
Subcutaneous injection of histamine	McIlroy	1928	Cat

In our experiments, we have studied the influence of various doses of histamine on the healing of mucosal defects in the stomach of the cat and dog. These defects were cut with a sharp scalpel so that the amount of tissue destruction was definite. In some of the experiments previously mentioned, chemicals or the cautery were used and the amount of destruction of tissue was indeterminable.

METHODS

Full grown cats from 2.8 to 4 kilograms in weight and dogs ranging from 12 to 16 kilograms in weight were used. Artificial defects were produced in the mucosa of the stomach. Two areas of the stomach were chosen for study, one on the lesser curvature or posterior surface, 1 to 3 centimeters from the pylorus, and the other high in the fundus on the greater curvature, 4 to 8 centimeters from the cardiac orifice. Under ether anæsthesia the abdomen was opened and the stomach incised longitudinally through its anterior surface at about the junction of the middle and lower thirds. The site selected for the defect was then grasped with a clamp, evaginated through the incision, and stretched out flat. An area of mucosa measuring approximately one square centimeter was then excised. The surface of the resulting defect was usually scarified lightly in criss cross fashion with a scalpel. In a few instances this was not done. Originally it was intended to make tracings of the defects and measure their size at the beginning and end of each experiment, but the variable state of contraction of the stomach rendered this procedure inaccurate and the plan was, therefore, abandoned.

The subcutaneous administration of histamine[1] was started on the day following operation and continued until the animal was chloroformed. Most of the animals were fed on the routine laboratory diet. For the cats this consisted of milk, meat, and vegetables, and for the dogs, meat, bread, and vegetables. A few cats received salmon in addition. The food was given at noon and taken away on the following morning. As a rule the cats ate intermittently and the amount of food eaten in a given period of the day could not be controlled. At autopsy the stomach was removed, distended with Jores solution, and opened after fixation.

RESULTS

1. *Effective dose of histamine for interfering with the healing of a prepyloric lesion in the cat.* The influence of various doses of histamine on the healing of prepyloric mucosal defects was studied in a series of 26 cats. The amounts of histamine and the effect on the

[1] "Ergamine" acid phosphate, Burroughs-Welcome and Company.

TABLE I.—EFFECT OF HISTAMINE ON PREPYLORIC MUCOSAL DEFECT IN THE CAT

Number	Histamine mg. per kilo	Duration days	Macroscopic interference with healing
11699	0.23 b.d.	7	No
11709	0.6 b.d.	7	No
11710	0.9 b.d.	7	Yes
11956	1.1 b.d.	7	Yes
11678	1.1 b.d.	6	Yes
11900	1.2 b.d.	14	Yes
11994	1.2 b.d.	6	Perforation
11649	1.4 b.d.	7	Yes
11792	1.5 b.d.	7	Yes
11738	1.5 b.d.	10	Perforation
11793	1.5 b.d.	7	Yes
11753	1.6 b.d.	3	Death due to toxicity of histamine?
11754	1.6 b.d.	5	
11996	1.2 b.d.	21	Yes
11718	1.2 o.d.	7	No
11995	1.2 o.d.	7	No
11957	2.0 o.d.	7	Yes
11872	2.0 o.d.	7	Yes
11918	2.0 o.d.	14	No
11955	2.5 o.d.	14	Yes
11810	3.0 o.d.	7	Perforation
11811	3.0 o.d.	7	Yes
11820	3.0 o.d.	7	Yes
11719	1.4 q.2 d.	7	No
11767	0.15 4 i.d.	7	Yes
11775	0.15 4 i.d.	7	Yes
11776	0.15 4 i.d.	7	Yes

gross appearance of the lesions is summarized in Table I. Twelve animals received the drug twice a day in doses ranging from 0.23 to 1.6 milligrams per kilogram. They were sacrificed after periods of 6 to 14 days. When the dose in this group exceeded 0.9 milligram per kilogram definite interference with healing could be seen in the gross appearance of the lesion. A detailed description of the pathological findings is given below. An alteration in the picture of healing was evident microscopically with smaller amounts of histamine and was seen with a dose of only 0.23 milligram per kilogram twice a day.

Another group of 8 animals in this series received histamine once a day. The amounts given ranged from 1.2 to 3.0 milligrams per kilogram. Doses of 2.0 milligrams per kilogram or more caused a definite interference with healing as judged both grossly and microscopically, whereas 1.2 milligrams per kilogram had no apparent effect.

TABLE II.—EFFECT OF HISTAMINE ON MUCOSAL DEFECTS HIGH ON GREATER CURVATURE

Number	Histamine mg. per kilo	Duration days	Macroscopic interference with healing
11679	0.79 b.d.	6	No
11710	1.1 b.d.	7	No
11956	1.1 b.d.	7	Yes
11792	1.5 b.d.	7	No
11793	1.5 b.d.	7	No
11995	1.2 o.d.	7	No
11957	2.0 o.d.	7	No
11955	2.5 o.d.	14	No
11810	3.0 o.d.	7	No

Three animals with prepyloric defects received four doses of the drug per day. The amount given to each was 0.15 milligram per kilogram twice in the morning and twice in the afternoon, each pair of doses being given a half-hour apart. At the end of 7 days all showed marked interference with healing.

Although a given dose of histamine may cause considerable distortion in healing as seen after one week, at the end of 2 weeks, healing may nevertheless occur. If the dose is sufficiently large, however, the lesion will remain open for 2 weeks. To prevent healing for at least 2 weeks, 1.2 milligrams per kilogram twice a day was found to be effective. With a dose of 2.5 milligrams per kilogram once a day, healing was not complete at the end of 2 weeks, although epithelialization was taking place.

II. *The influence of histamine on the healing of a lesion high on the greater curvature of the cat's stomach.* The effect of histamine on the healing of mucosal defects on the greater curvature, high in the fundus of the stomach, was studied in 8 cats. Most of these animals also had prepyloric lesions. The doses of histamine ranged from 0.79 to 1.5 milligrams per kilogram twice a day and 2.0 to 3.0 milligrams per kilogram once a day. The results are given in Table II. In general, no delay of healing was found grossly or microscopically

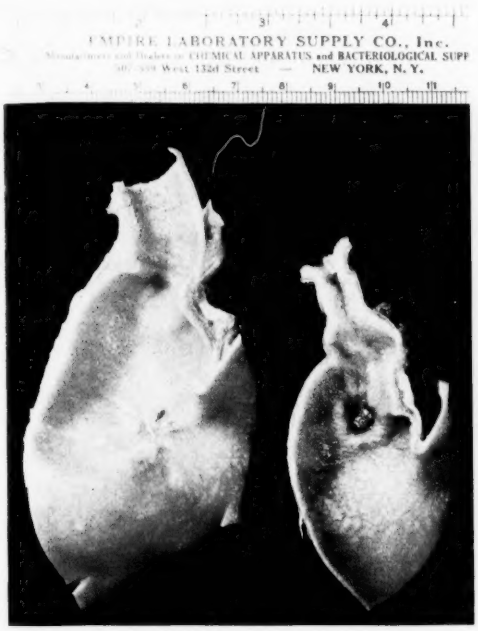

Fig. 1. Prepyloric defects in the cat 1 week after operation. One animal (specimen on right) received 1.2 milligrams per kilogram of histamine twice a day. The other received none.

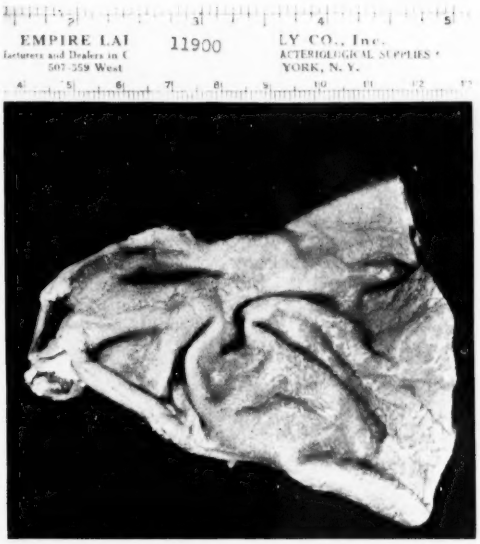

Fig. 2. Prepyloric defect in the cat. Histamine 1.2 milligrams per kilogram twice a day for 2 weeks. Note roughening of gastric mucosa.

with the smaller doses. Neither did the greater number of cats receiving large doses of the drug show a delay in healing. However, one animal which received 1.1 milligrams per kilogram twice a day for 7 days showed definite interference with healing grossly, while another which received 1.5 milligrams twice a day showed microscopic evidence of delayed healing at the end of the same period of time. This tendency of the mucosal defect near the cardia to heal, even though the prepyloric lesion in the same cat showed delay in healing, was apparent in practically all the animals.

III. *The effect of histamine on the healing of a mucosal defect near the pylorus of the dog's stomach.* Three dogs were used in all. Defects 2 centimeters square were made in the stomach near the pylorus. One dog served as a control. Another received 0.6 milligram of histamine per kilogram three times a day. At the end of a week the animal was killed and the defect showed normal healing both grossly and microscopically. The third dog received 1.3 milligrams per kilogram twice a day. The defect in this animal showed the same type of interference with healing at the end of a week as occurred in the stomach of the cat with the same relative dose of histamine.

PATHOLOGY

I. *Healing of prepyloric mucosal defect in control animals.* The normal healing of the prepyloric mucosal defect of the cat was studied in 6 controls. Grossly, after 1 week the defect was found to be rounded, measuring about one-quarter of the original size, and the edges were smooth and not indurated. The floor was covered with granulation tissue and was almost flush with the surrounding mucosa. Histologically, new epithelium was seen growing across the ulcer. Its cells were flattened out. In the center, the surface was covered with only a little or no necrotic débris. At the edges of the original defect the new epithelium was columnar and the masses of cells dipped downward to form cyst-like structures suggesting newly forming gastric glands. Beneath the regenerating epithelium there was a moderate proliferation of granulation tissue and a few wandering cells were present.

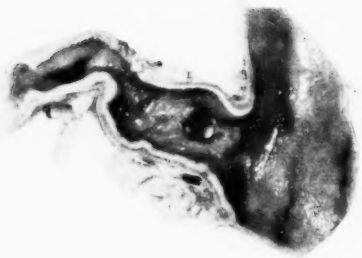

Fig. 3. Perforated prepyloric ulcer in the cat. Histamine 1.5 milligrams per kilogram twice a day for 10 days.

At 2 weeks, the prepyloric lesion was healed and was represented by only a small puckered area in the mucosa covered by new epithelium.

II. *Effect of histamine upon prepyloric mucosal defects.* Grossly, the prepyloric defect, after 1 week of an adequate amount of histamine, appeared very different from the control. It was larger, having contracted to only about one-half its original size. It was usually oval in shape with its longer diameter corresponding to the long axis of the stomach. The edges were elevated and indurated and the floor was deeper and covered with a brown or greyish slough. Sometimes, however, the defect maintained its original shape and aside from some diminution in size and increase in the amount of induration showed little alteration from the original appearance produced at operation.

At 2 weeks the defect was smaller, the induration was more marked, but the floor was shallower and epithelium was growing in from the edges.

Microscopically, at 1 week the surface of the prepyloric ulcer was always covered with a layer of exudate, consisting of necrotic material in which fibrin, pyknotic nuclei of polymorphonuclear leucocytes, and a few desquamated epithelial cells were identified. Beneath this exudate, there was granulation

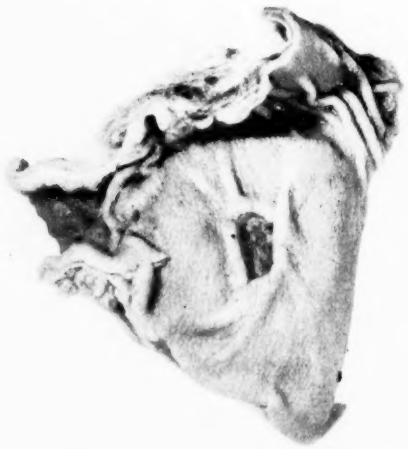

Fig. 4. Indurated prepyloric lesion in the dog. Histamine 1.2 milligrams per kilogram twice a day for 7 days.

tissue. The latter had filled in the areas where the muscularis was scarified and was growing upward into the lower layer of the exudate on the surface. No alteration was seen in the blood vessels at the periphery. The edges of the ulcer were steep and covered with epithelium which often turned downward to form a trough. The epithelium was arrested where it had reached the exudate on the surface. Sometimes it grew downward in the substance of the submucosa. The cells contained frequent mitotic figures. The gastric glands at the edges of the ulcer were sometimes increased in length and the stroma between them appeared slightly œdematous, sometimes moderately infiltrated with a number of lymphocytes. The cut edges of the muscularis mucosæ were curved down and backward. In the submucosa beneath the edges of the ulcer, there was usually a proliferation of granulation tissue, accounting for the induration noted in the gross specimen.

The extent of these changes described was in proportion to the amount of histamine

Fig. 5. Prepyloric defect in the cat, 7 days after operation. No histamine. Normal healing.

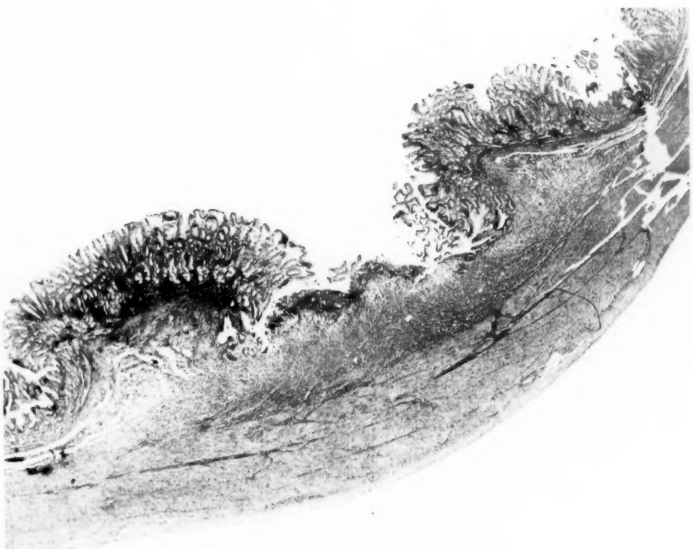

Fig. 6. Prepyloric defect in the cat, 7 days after operation. Animal received 0.23 milligram per kilogram of histamine twice a day.

given and the frequency of its administration. With the larger, more frequently administered doses, the amount of necrotic exudate was most abundant and healing correspondingly retarded. With the smaller doses there was relatively little necrosis, but instead, an excessive proliferation of granulation tissue.

After 2 weeks of the larger doses of histamine, there was less slough on the surface of the ulcer and the granulations were filling in the defect. Flattened out new epithelium was beginning to grow across the surface.

Perforation occurred in 3 animals, death resulting on the fifth, seventh, and tenth days, respectively, from acute diffuse peritonitis. The ulcers in these instances were funnel shaped with steep edges. The floor of the ulcer presented a punched-out appearance and the edges were markedly indurated.

III. *Mucosal defects high on the greater curvature of the stomach.* The repair of the control defects high in this area took place a little more rapidly than it did in the control lesions situated at the prepyloric region. With histamine the gross and histological pictures of healing in this locality could not be differentiated from the controls in most

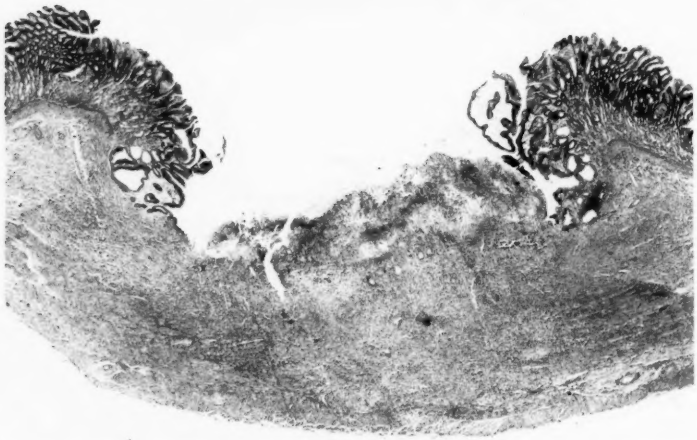

Fig. 7. Prepyloric defect in the cat, 7 days after operation. Histamine 0.9 milligram per kilogram twice a day. Interference with healing.

Fig. 8. Prepyloric defect in the cat. Animal received 1.1 milligrams of histamine per kilogram twice a day for a week.

instances. A few lesions, however, presented the same characteristics of delayed healing described for the prepyloric lesions, but to a lesser degree. Those with delayed healing were described grossly.

Effect of histamine on the intact gastric mucosa of the cat. Erosions of the gastric mucosa have been reported following prolonged administration of histamine in various animals. Buechner, Siebert, and Molloy found gastric erosions in a large percentage of rats receivin histamine. These animals were starved ever other day. The lesions occurred chiefly i that portion of the stomach lined with squa mous epithelium. They were really areas o epithelial hyperplasia with eroded surface Matsueda also reported the occurrence o ulcerative lesions in the stomachs of guine pigs, rabbits, and dogs after large doses o histamine given for a number of weeks. H

Fig. 9. Mucosal defect high on the greater curvature of the cat's stomach after 1.5 milligrams of histamine per kilogram twice a day for a week. Histamine has little effect upon healing in this region.

did not describe the type of diet given to these animals.

We obtained gastric erosions following the injections of histamine in only 1 animal in this series. Several, though, had a few erosions at the lower end of the œsophagus, but not in the stomach. The gastric mucosa, after distention and fixation, was usually smooth and similar in appearance to the controls. However, the stomachs of 6 cats receiving histamine did show striking changes in their gross appearance of a different nature. The surfaces of these stomachs were mottled with whitish, elevated streaks. The mucosa was roughened and leathery in texture. Sometimes, in addition, there were marked mamelonations. These changes involved both the antrum and the fundus of the stomach and are best shown in the accompanying picture. The amount of histamine administered to each animal which presented this finding is given in Table III.

SUMMARY

The action of histamine has recently been completely reviewed by Best and McHenry and does not need further elaboration here. An explanation of the mechanism of the delay of healing after the administration of histamine awaits further investigation.

Histamine was found to cause a pronounced change in the healing of artificial mucosal defects in the prepyloric region of the stomachs of the cat and dog. There was increased destruction of tissue in the floor of the ulcer. The mucosal epithelium did not grow across the surface of the defect so rapidly, as in the controls. When healing did begin, connective tissue proliferation took place in excessive amount in the floor and edges of the ulcer, resulting in induration of the lesion. The extent of the delay of healing was proportional to the amount of histamine given. The amount of the drug which must be given in order to delay the healing of a mucosal defect of approximately 1 square centimeter for 2 weeks was in the neighborhood of 1 to 1.2 milligrams per kilogram twice a day. Doses appreciably less than this interfered with healing but had little effect on the length of healing time of the lesions of this size.

The administration of doses of histamine larger than 1 to 1.2 milligrams per kilogram twice a day was prohibited by the toxic symptoms resulting. McIlroy who used 10 to 20 milligrams every other day for the cat did not mention toxic symptoms. In our experience this amount of histamine caused violent vomiting, salivation, and passage of watery stools within a few minutes after injection of the drug. The animals lost appetite and weight. Two cats in the present study, receiving 1.6 milligrams per kilogram twice a day,

TABLE III.—CATS WHICH PRESENTED GROSS ALTERATION IN THE APPEARANCE OF THE GASTRIC MUCOSA

Number	Histamine per kilogram	Duration—days
11950	1.1 b.d.	7
11900	1.2 b.d.	14
11793	1.5 b.d.	7
11872	2.0 o.d.	7
11811	3.0 o.d.	7
11767	0.15 4 i.d.	7

presented these symptoms and died after 3 to 5 days. At autopsy no cause of death was found and death was attributed to the toxicity of the drug. Doses of 3.0 milligrams once a day also produced vomiting. These symptoms were usually avoided or were minimal with 1 to 1.2 milligrams twice a day, although vomiting did occur occasionally with this amount.

Histamine had little effect in delaying the healing of mucosal defects high on the greater curvature. In a few instances, however, it caused, to a lesser extent, the same changes found regularly in the prepyloric region. This capacity of the lesion high on the greater curvature to heal as contrasted to the delay in healing of the lesion in the prepyloric region is of interest because of the infrequency of chronic gastric ulcers high on the greater curvature in man. It is of interest, also, that despite the profound necrosis resulting from an adequate dose of histamine these lesions finally healed. Apparently, the necrotizing agent was diminished in amount or potency, or the factors inhibiting its action were increased as time passed. That the balance in favor of healing was not always established, however, was demonstrated by the three instances in which perforation of the remaining stomach wall occurred.

Finally, in a minority of animals, histamine caused an alteration in the gross appearance of the stomach, suggesting a gastritis. Further study on this finding is in progress.

CONCLUSIONS

1. The subcutaneous administration of histamine interfered with the healing of a mucosal defect in the prepyloric portion of the stomach of the cat and dog. It delayed but did not prevent healing in this region of the stomach.

2. Histamine had little effect on the healing of a mucosal defect high on the greater curvature of the stomach.

3. The effect of repeated doses of histamine upon the appearance of the mucosa of the stomach is described.

4. The amount of histamine required to delay the healing of a prepyloric mucosal defect in the cat for 2 weeks is 1 to 1.2 milligrams per kilogram twice a day.

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HISTOPATHOLOGY OF ANAL CRYPTS[1]

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INFECTION of the anal crypts is, according to Rankin, Bargen, and Buie, the principal cause of anal fistula, spastic conditions of the sphincter, periproctitic abscess, and hæmorrhoids. Not only these local conditions, which actually constitute the majority of anal diseases, are attributed to the inflammation of the crypts of Morgagni. In a recent paper, Hirschman called the attention to the important rôle that infected crypts may play in producing general symptoms, such as neuralgia, muscular pains, headaches, insomnia, and certain skin eruptions. In his opinion, anal cryptitis is probably the most frequently overlooked source of focal infection that is present in the human body today.

While the clinical importance of infected anal crypts is generally admitted, histological data on this common disease are surprisingly meager. Current descriptions of anal cryptitis, as presented in the surgical literature, are obviously based only on clinical and macroscopic observations. According to Rankin, Bargen, and Buie, the Morgagni crypts are surrounded by lymphoid tissue and are susceptible to all traumatic influences which attack the rectal outlet. Anything which produces a break in the tissues about the anal crypts with subsequent admission of pyogenic bacteria may result in infection of these crypts. Thus the infected crypts become œdematous, in the opinion of these authors, and the papillæ become inflamed and adherent over the crypts. This nidus of infection is the beginning of anal fistula.

Hirschman describes the crypts of Morgagni as openings in the mucous membrane of the anal canal, usually crowned by small papillæ. When diseased, these crypts are red and the papillæ are pinkish white, enlarged and elongated, sometimes polypoid. Hirschman could often demonstrate pus in the crypts and not infrequently a sinus or a blind fistula was found leading from a diseased crypt. These sinuses varied in length from 1 to 5 centimeters and extended in a radial direction from the crypts.

Since we were unable to find in the available literature any detailed microscopic description of the lesions causing the clinical picture of anal cryptitis, we studied histologically 331 hæmorrhoids and 89 infected crypts, removed at St. Francis Hospital. It was hoped that these examinations might furnish a solid basis for the understanding and treatment of this common disease.

The first and most unexpected result of our studies was the observation that in uncomplicated cases of so called cryptitis, the mucosa of the Morgagni crypts proper was not the primary seat of the infection, but was usually normal. Without exception our specimens showed that the pathological process had its origin in narrow, duct-like structures which opened into the crypts of Morgagni (Fig. 1). They were either simple tubules (Fig. 2) or complex, branching ducts (Fig. 3) which extended from the mucosa of the anal crypts, passed into or through the muscular coat of the bowel, and ended blindly in the connective tissue.

In acute infection, the lumen of these tubular structures was filled with pus cells and the wall was infiltrated with neutrophile leucocytes (Fig. 4). In subacute or chronic cases, the wall of the ducts was formed by granulation tissue or dense fibrous tissue, infiltrated with round cells and wandering cells (Fig. 5). That these infected tubules were not fistulous tracts caused by burrowing of an inflammatory process from the anal crypts into the tissue adjacent to the anal canal, was evidenced by the presence of epithelial cells lining parts of these ducts. There were stratified squamous cells in the wall near the opening of the duct; deeper inward the lining changed to transitional epithelium and finally to columnar epithelium in two or more layers. In several infected ducts, a layer of columnar cells was present only in their blind ends,

[1]Read before the American Proctological Society, June 12, 1933.

Fig. 1, left. Primary lesion of purulent infection of anal duct. Destruction of the epithelial lining in the blind end of one branch of duct is clearly shown. Beginning leucocytic infiltration of surrounding connective tissue is see

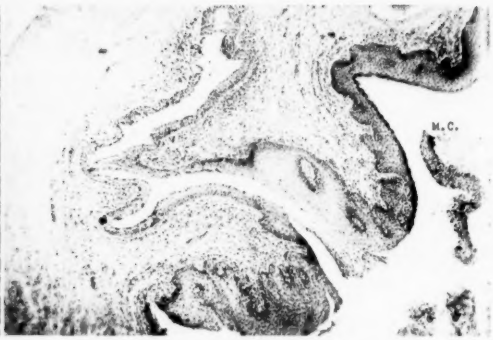

Fig. 2. Preformed tubular anal duct without inflamm tory changes. *M.C.*, Morgagni crypt.

Fig. 3, left. Branching anal duct opening into Morgagni crypt, *M.C.*, without inflammation.

Fig. 4. Acutely inflamed anal duct. The epithelial lining of the duct is completely destroyed except in the blind end. Leucocytes are infiltrating the wall of the duct and are found within the lumen.

while the other portions of the wall were entirely devoid of epithelium.

The form of these anal ducts, especially that of the branching variety, resembled so closely that of excretory ducts of glandular origin that it seemed unlikely that these structures were the result of an ulcerous process burrowing from the Morgagni crypts into the surrounding tissue. By examining surgical and postmortem specimens of cases without inflammatory changes, we were able to demonstrate in most instances well developed tubular structures which run from the Morgagni crypts into the submucosa and sometimes into the internal sphincter muscle. In no case, however, were we able to find in human material true glandular tissue in connection with these ducts. Only in a few ducts were clear cells present in the epithelial lining. The nucleus of these cells was basally located and the high protoplasm was filled with a clear secretory material (Fig. 6). The latter did not give the reaction of mucin. That these anal ducts were preformed and not inflammatory products, was further proved by the demonstration of the same structures in human newborn and in the fetus (Fig. 7).

To obtain more information about the biological significance of these ducts, we examined histologically the anal region of rabbits, guinea pigs, cats, and dogs. In cat (Fig. 8) and dog (Fig. 9), the same anatomical structures were found, but they were more fully developed than in man. In both species, the

Fig. 5, left. Anal duct from a case of recurrent so called cryptitis. Large areas of the duct wall are entirely devoid of epithelium. Regenerating squamous epithelium is shown creeping into the duct from the crypt of Morgagni, *M.C.*

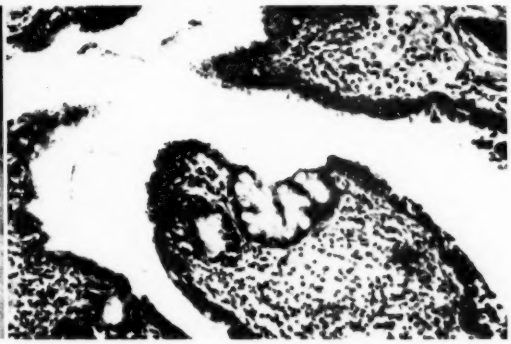

Fig. 6. Transverse section of normal anal duct. Group of clear cells, filled with secretion, in the epithelial wall.

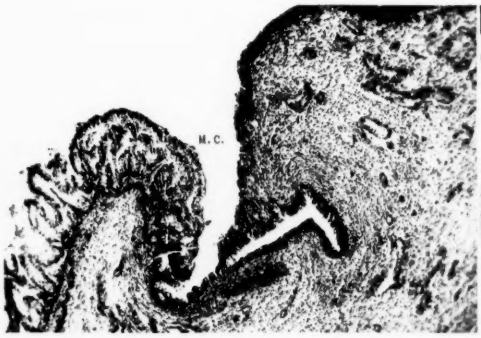

Fig. 7, left. Well developed anal duct in 4 month fetus.
Fig. 8. Anal region of newborn cat. Glandular organ between internal and external sphincter muscle. Excretory duct opens into crypt of Morgagni, *M.C.*

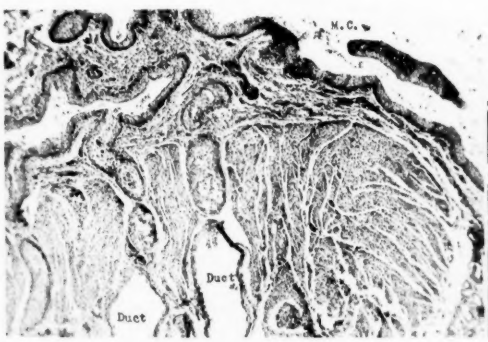

Fig. 9, left. The anal canal of a dog. The anal ducts extend from the Morgagni crypt, *M.C.*, into the internal sphincter muscle.

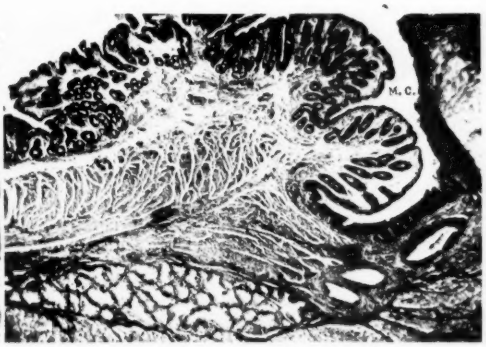

Fig. 10. Anal region of the rabbit. Large alveolotubular gland in external sphincter muscle. Excretory duct communicates with crypt of Morgagni, *M.C.*

anal ducts communicated with definite, though scanty glandular acini which were lying within the fibers of the internal sphincter or between internal and external sphincter muscle. The excretory ducts of these glands resembled, in form and epithelial lining, exactly those found in man. In the rabbit (Fig. 10), a very voluminous alveolotubular gland was found within the external sphincter muscle. It consisted of many lobules, the acini were formed by columnar cells and the lumina contained a light stained material which did not give the reaction of mucin. We are unable to say anything definite about the chemical composition of the fluid secreted by these anal glands, and we do not know whether these glands of the rabbit produce a lubricant to the fæces just before their extrusion from the anal canal or whether they are smell glands which fulfill some function in sex attraction. Since in the rabbit and the other species examined, the excretory ducts of these glands opened into the same region as in man, the conclusion seems justified that the anal ducts in man are remains of complex glandular organs as they are found in the lower orders of mammals.

The question has often been raised why we have inflammatory processes so frequently in and about the anal canal. We believe that our findings of preformed, narrow, tubular structures in this region explain the frequency of anal infection. Communicating as they do with the bowel lumen these anal ducts afford a ready path for infective organism such as colon bacillus, proteus, staphylococcus, streptococcus and so forth. Length and direction of these anal ducts which we regard as remains of complex glandular organs determine, in our opinion, the extension of an anal infection. Bacteria may easily penetrate, as we have seen in our specimens, through small defects in the epithelial lining of these ducts and gain entrance into the surrounding muscular or fibrous tissue. By burrowing from there into the ischiorectal fat tissue the purulent process may lead to an abscess in this region. By perforation of the suppuration through the mucosa or epidermis, a complete internal or external anal fistula may result.

The existence of preformed epithelial tubules explains furthermore the clinical fact that so called cryptitis and anal fistula do not heal, as a rule, by conservative therapeutic measures. Since in most inflamed anal ducts small areas of the interior epithelial lining are preserved, regeneration of the epithelial wall will take place after subsidence of the infection and will prevent obliteration of the ducts by scar tissue. The ducts will thus stay open and give entrance to recurrent infection. It is a common experience that, with fistulous epithelial tracts in any region of the body, complete healing will not occur as long as part of the epithelial lining remains and that the whole tract has to be removed to obtain a permanent cure.

It seems surprising that these interesting and, from a pathogenic standpoint, important structures have been almost completely overlooked in the recent literature. In the modern American proctological literature where the subject of infected anal crypts is widely discussed, the presence of these ducts is not suspected. There are very few references in the European literature. Herrmann, in 1880, described these anal ducts in a beautifully illustrated thesis as normal findings in the dissecting room. In 1902, Tavel reported a case of recurrent purulent periproctitis which he attributed to infection of ducts and cysts found in the surroundings of the anal canal. In the last 30 years, only one brief mention is made of these structures, namely by Lockhart-Mummery in the *Proceedings of the Royal Society of Medicine*, 1929, who regards infection of these normally present glandular ducts as one of the many causes of anal fistula.

SUMMARY

1. Histological study of 331 surgically removed hæmorrhoids and 89 infected anal crypts revealed the presence of preformed anal ducts which opened into the crypts of Morgagni.

2. These ducts are regarded as remains of complex glandular organs as found in the lower orders of mammals.

3. The narrow, tubular structures afford a ready path for infective organism, communicating as they do with the bowel lumen.

4. So called cryptitis, anal fistula, periproctitic abscess have their origin in these pr

formed anal ducts. Length and direction of these structures determine the extension of an anal infection.

5. The existence of preformed epithelial tubules extending from the anal canal into the surrounding tissue explains the frequency of anal infection and the clinical fact that so called cryptitis and anal fistula do not heal, as a rule, when the method of treatment which is carried out consists of conservative therapeutic measures.

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INTRA-ABDOMINAL PRESSURES CREATED BY VOLUNTARY MUSCULAR EFFORT

III. Relation to Body Measurements, with a Comment on Etiology of Genital Prolapse

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IT has long been a matter of clinical observation that stout women are more prone to develop genital prolapse than thin women. Consequently, the question arose whether stout women, and more generally women whose bodily measurements are at the upper limits of normal, might create unusually high pressures within the abdomen during the course of routine daily activity. It was further suggested that intermittently created high pressures might be a factor in the causation of prolapse of the uterus and vaginal walls. Therefore, the present study of 60 normal women was undertaken in an effort to reach a greater understanding of intra-abdominal pressure conditions resulting from voluntary muscular effort, especially in relation to the part pressure may play in the causation of prolapse.

MATERIALS AND METHODS

The subjects included 60 women of ages varying between 18 and 60. Fifty of them were inmates of the Philadelphia House of Correction, and the remaining 10 were secured from other sources. All of them were healthy at the time of testing. As the nature of the experiment necessitated maximum voluntary muscular activity, only women who were willing to be tested were used.

The method of testing was identical with the technique developed and used in collecting the data for the first two papers (2, 3) of this series. Briefly, each subject strained maximally 20 times at intervals of not less than 1 minute upon an air inflated balloon within the vagina, and readings were made on a mercury manometer connected with the balloon. It has been demonstrated previously (3) that this method gives a satisfactory measure of pressure created within the abdomen by muscular effort.

In addition, the age, abdominal girth, height, and weight of each subject were recorded.

RESULTS

All the data, including results of 1200 tests upon the 60 women, are given in Table I. Each pressure recorded in the table is, therefore, the average of 20 tests on a single woman.

In order to determine whether the pressures were related to any of the other measurements, they were plotted in 4 scatter diagrams, Figures A, B, C, D, according to age, abdominal girth, height, and weight, respectively. It will be seen at a glance that these charts are true "scatter diagrams" in the sense that the individual points are so scattered that no relationships seem to exist.

In addition, four different groupings of the data, each comparing the average pressure created by one-half the subjects against that created by the other half, were made. For example, the average pressure created by the 30 youngest women was compared with the average pressure created by the 30 oldest. Completely rearranging the data, the average pressure created by the 30 women with the smallest abdominal girths was compared with that of the 30 women with the largest abdominal girths. A third and fourth rearrangement of the data were made so that the average pressure created by the 30 shortest versus that created by the 30 tallest women, and the average pressure created by the 30 lightest versus that created by the 30 heaviest women could be compared. The results are given in Table II. The pressure difference did not exceed 1.0 centimeter of mercury in any of the 4 categories: age, girth, height, or weight. It will also be seen from Table II that each difference falls far below 3 times the standard error, the accepted statistical standard of significant difference.

TABLE I.—SUMMARY OF DATA

Identification	Age years	Height cm.	Weight kg.	Girth at umbilicus cm.	Average pressure created cm. Hg.	Identification	Age years	Height cm.	Weight kg.	Girth at umbilicus cm.	Average pressure created cm. Hg.
1	18	164.4	57.8	64.0	11.2	31	28	161.2	49.3	63.0	9.8
2	19	149.9	46.8	63.0	12.6	32	29	166.3	61.3	70.0	10.6
3	19	157.5	53.5	60.5	18.6	33	30	165.1	88.7	104.0	17.5
4	19	162.5	60.9	66.0	12.4	34	30	155.0	55.3	74.0	11.4
5	19	155.0	53.6	71.0	12.7	35	31	160.0	48.6	68.0	10.1
6	19	156.0	71.4	73.7	15.7	36	31	155.6	50.9	66.1	14.9
7	19	161.2	64.5	75.0	13.3	37	32	151.2	53.6	71.5	13.4
8	20	163.9	64.9	73.0	12.8	38	33	167.0	55.0	70.0	12.0
9	21	157.5	57.5	66.0	13.5	39	33	152.4	48.6	67.0	13.0
10	21	155.0	56.6	69.5	14.6	40	34	160.0	54.8	65.0	11.8
11	21	155.0	48.6	64.0	14.4	41	36	157.5	57.5	79.0	10.6
12	21	162.5	119.7	109.0	14.0	42	38	160.0	56.2	83.0	19.6
13	21	160.0	51.6	65.5	13.5	43	38	155.0	44.6	65.5	8.6
14	22	157.5	54.6	68.0	9.5	44	38	166.0	63.6	76.5	12.9
15	22	149.8	45.2	61.0	12.1	45	38	160.0	49.5	73.0	11.2
16	22	162.5	55.3	74.0	7.9	46	38	159.0	120.0	131.0	13.7
17	22	157.5	51.6	69.0	7.7	47	39	155.0	61.8	75.0	12.3
18	22	153.2	43.2	58.0	10.0	48	40	157.5	69.6	87.5	9.8
19	23	160.0	58.2	67.0	12.0	49	40	160.0	53.8	70.0	13.5
20	23	155.0	52.7	68.5	17.2	50	40	156.2	76.8	94.0	8.5
21	24	160.0	45.4	61.0	11.1	51	42	139.8	50.6	78.0	12.1
22	24	156.2	63.2	71.0	9.6	52	42	145.0	62.2	97.0	9.6
23	24	165.1	81.5	83.0	23.2	53	43	165.1	81.6	95.0	15.7
24	25	148.0	48.2	71.2	13.5	54	43	162.5	77.7	97.0	18.8
25	26	165.1	59.6	71.0	15.0	55	46	160.0	47.4	68.0	12.5
26	26	155.0	86.8	93.0	18.8	56	46	167.7	89.1	102.0	12.8
27	27	162.5	55.4	71.0	8.9	57	48	166.3	68.7	82.0	14.8
28	27	172.7	73.3	82.0	12.1	58	49	163.0	95.4	132.0	11.2
29	27	172.7	65.9	70.0	15.0	59	54	156.2	65.0	101.0	17.9
30	27	144.8	50.0	65.3	15.3	60	60	165.1	65.4	93.0	8.6

Each pressure average is based upon 20 measurements.

TABLE II.—RELATION OF PRESSURE TO AGE, GIRTH, HEIGHT, AND WEIGHT

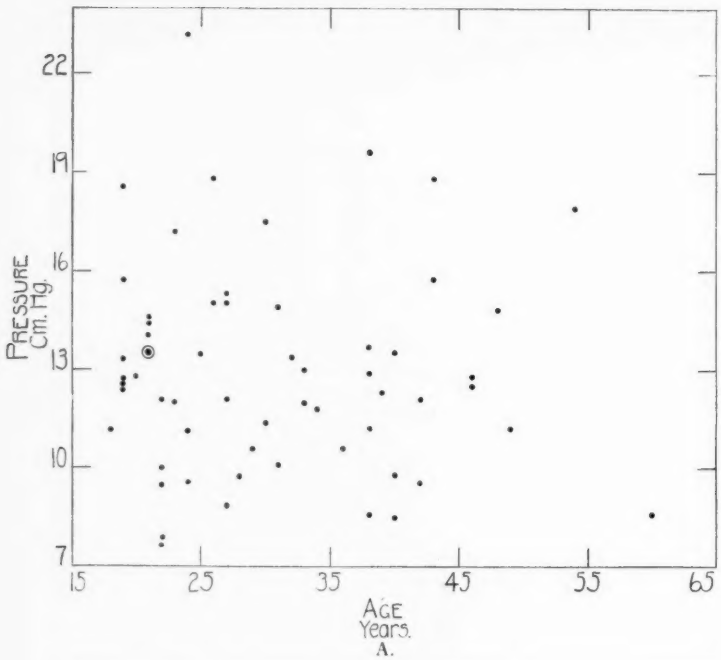
Grouping	Average age, girth, height, and weight of each half of each grouping		Average pressures of each half of each grouping (cm. Hg.)		Difference between 1st and 2nd 30 (cm. Hg.)	3 times the standard error of the difference
	1st 30	2nd 30	1st 30	2nd 30		
Age	22.3 yrs.	38.9 yrs.	13.3	12.6	0.7	7.7
Girth	66.4 cm.	87.7 cm.	12.5	13.4	0.9	10.5
Height	153.9 cm.	163.7 cm.	12.8	13.1	0.3	7.7
Weight	51.0 kg.	73.0 kg.	12.5	13.5	1.0	7.4

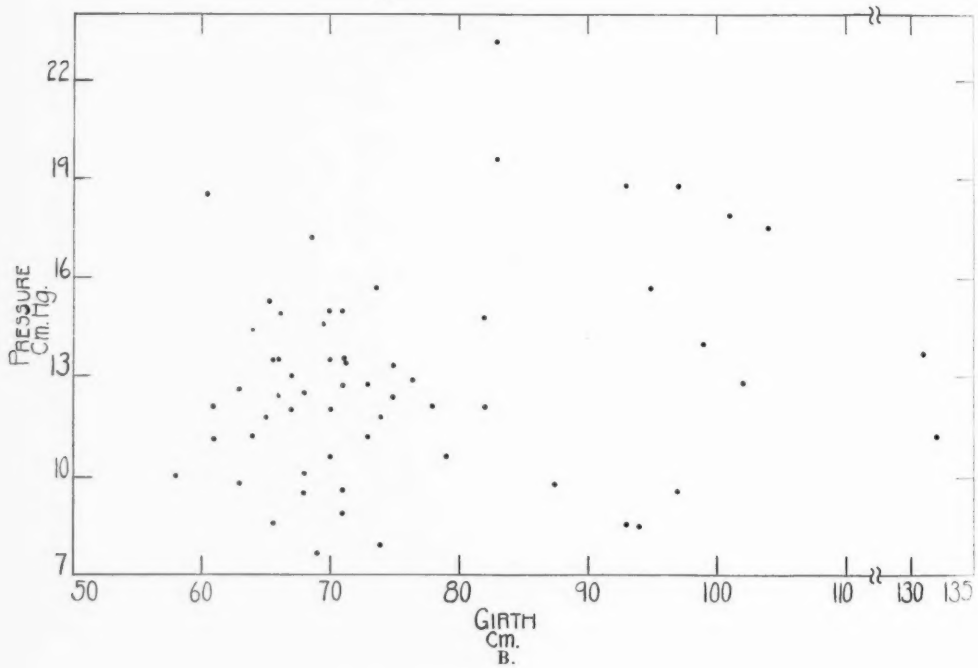
CONCLUSIONS

From a theoretical basis, static pressure within the abdominal cavity depends upon the tonus of the surrounding musculature

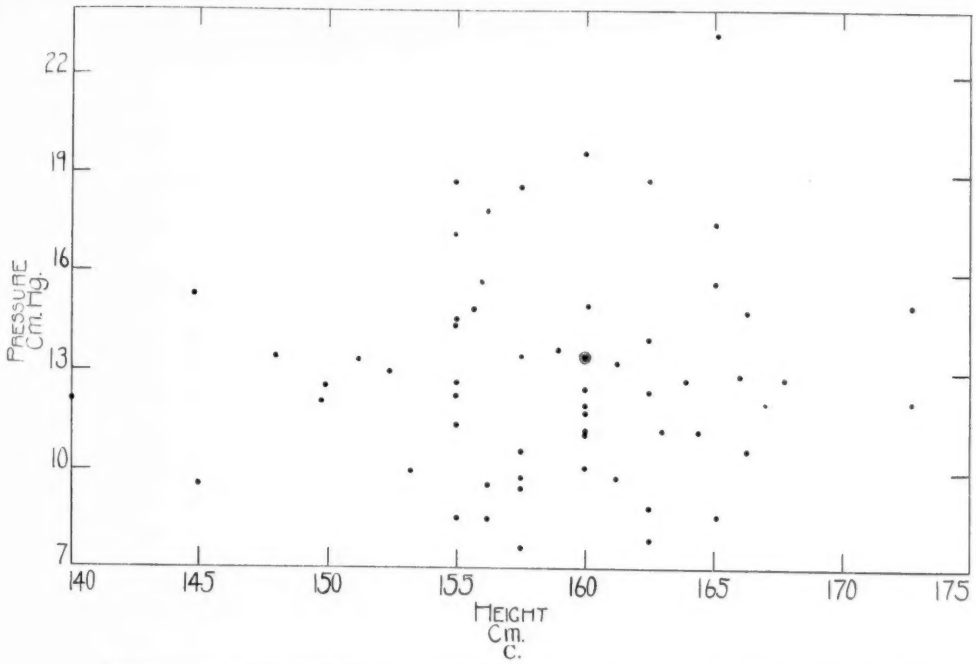
The average pressure created by the 30 youngest women compared with the average pressure created by the 30 oldest women. Also the comparison of the average pressure created by the 30 women with the smallest abdominal girths versus that created by the 30 women with the largest abdominal girths. Also similar comparisons with respect to height and weight.

Note: (1) the actual pressure difference between any two groups in the same category is very small, never exceeding 1.0 centimeter of mercury; (2) each difference falls far below 3 times the standard error of the difference, thus indicating it is not significant.





Figs. A, B, C, D. Scatter diagrams representing the relations between age, girth, height, and weight, and the ability to create intra-abdominal pressure. Abscissas are: A, age; B, girth; C, height; D, weight. Ordinates in each case are pressures created by the voluntary contraction of the abdominal musculature. Dots enclosed by circles represent two determinations falling at the same point. Note: the absence of any tendency toward any kind of orderly arrangement, thus indicating the total lack of relationships.


22
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PRESSURE Cm. Hg.
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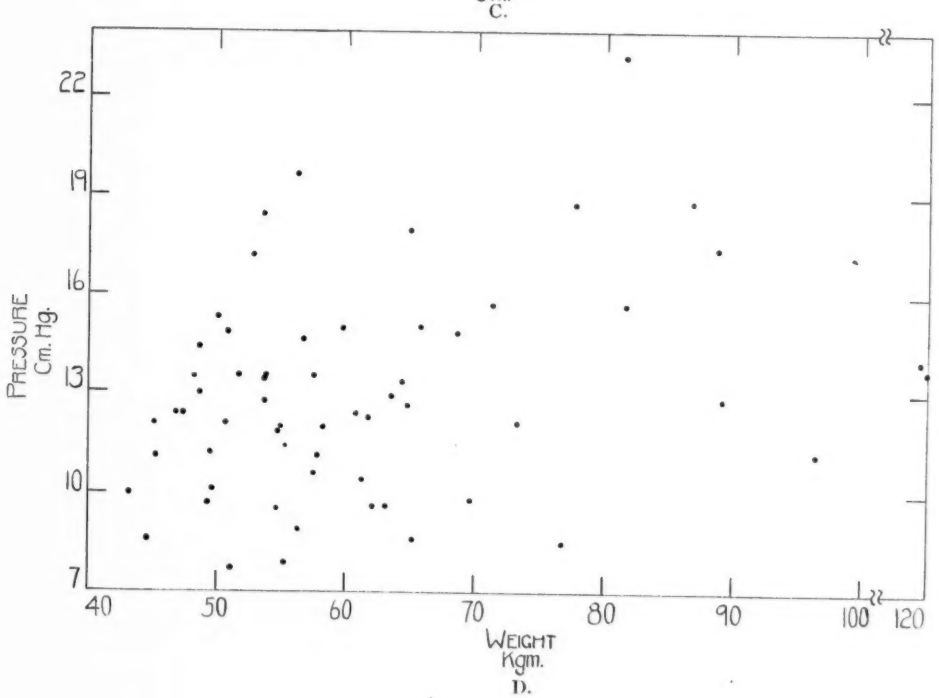
HEIGHT Cm.

C.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PRESSURE Cm. Hg.
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50
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90
100
120
WEIGHT Kgm.

D.

(Keith). As a corollary, pressures created by voluntary muscular effort must depend upon the development and efficiency of this musculature and only in a general way, if at all, upon body measurements.

Our findings bear out this theory. In a study of 60 normal women, we were unable to demonstrate any relation between age, girth, height, or weight, and ability to create pressures within the abdomen. Consequently, we feel that the obese woman is no more able to create unusually high intra-abdominal pressures than the thin woman with well developed abdominal, diaphragmatic, and pelvic floor muscles.

This suggests that if obese women are prone to develop genital prolapse it is not because they create higher intra-abdominal pressures than do other types.

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A NEW TREATMENT OF OSTEOMYELITIS

PRELIMINARY REPORT

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THE rôle of osteomyelitis in the general practice of medicine, and particularly in orthopedics, is too prominent and too well known to warrant or make necessary its discussion here. However, in passing, it may be well to point out some of the mechanics of osteomyelitis. The classical description of inflammation denotes the characteristic presence of calor, dolor, rubor, and tumor, but, as Hawk (1933) points out, inflammation in bone tissue is somewhat different from that in soft tissues. Here the tissue is rigid and swelling is consequently absent, though the other conditions are present. When the exudate, resulting from inflammation and constituting a defensive barrier, expands in osseous tissue, it is forced back into rigid channels. It becomes perfectly obvious, therefore, that in an acute bone inflammation rapid destruction of osseous tissue follows. It has been stated that bacteria causing bone infections are invariably virulent. This statement must stand, in view of the fact that even if the bacteria do become attenuated and the inflammatory process is stopped, with the normal functions of the body remaining unassisted, a chronic bone abscess persists. This abscess discharges for long, perhaps indefinite, periods of time because of its presence in rigid tissue which will not expand and permit efforts sufficient for healing. Inflammation is the manifestation of the tissues of their attempt to destroy the bacteria, render the bacterial toxins inert, remove the necrotic débris, and repair the tissue damage. Any treatment that aids the body in this work by stimulating the exudate and neutralizing the bacteria and their toxins, is desirable. Unfortunately, however, many treatments for osteomyelitis while designed for these purposes actually thwart them.

Many therapeutic procedures have been advocated and several are still in more or less common use. Notable among those treatments employed at present are the establishment of drainage gutters by surgical means, irrigation with Dakin's solution, Orr's method, maggot therapy, the use of bacteriophage, and packing with a paste made of glycerol and magnesium sulphate. Unfortunately, no single one of these treatments is effective in all cases and most of them offer little hope of successful results in any case.

One of the most recent of these treatments, and apparently the most successful, is that of the late Dr. William Baer of Johns Hopkins in which sterile living maggots, which feed exclusively upon necrotic tissue, are used. But even this treatment has some points in its disfavor and is contra-indicated in some cases.

NEW TREATMENT

Dr. Baer made the statement that probably some biochemical action of which he knew nothing was responsible for the apparent success of maggot therapy. Such a thought is very intriguing because, if a chemical substitute for maggots could be found, all of the disadvantages of Baer's method would thereby be entirely eliminated. With this idea in mind the writer began a series of experiments, reported briefly herein, in an attempt to determine how maggots effect a cure in cases of osteomyelitis. The idea of making an extract by macerating sterile maggots in sterile normal saline with a mortar and pestle was discarded because it was felt, in the first place, that an extract of practically any invertebrate made in this way would probably show some bactericidal properties and, in the second place, it was recognized that if a bactericidal extract were secured in this manner, accurate chemical analysis and consequent identification of the active principle, or principles, would be practically impossible. It is interesting to note here that Livingston and Prince (1932) subsequently, and independently, utilized this discarded technique and did secure a compound possessing bac-

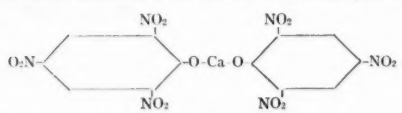
tericidal properties. Following the abandonment of the original idea it was decided to make extractions of living sterile maggots in a Soxhlet extractor, water, alcohol, acetone, and other chemicals being used as extracting agents. Alcohol and acetone extractions were made and no substances with appreciable bactericidal properties were secured. At this stage of the investigations it was accidentally discovered that the maggots (*Lucilia sericata* Meig) exude calcium carbonate through their body walls. It was found by means of the Roe and Kahn colorimetric method of calcium determination that one hundred maggots will excrete an average of 0.6 milligram of this substance each 24 hours. It was previously known that the larvæ of a great number of flies contain within their bodies a large quantity of stored calcium carbonate, but it is recorded nowhere that this is eliminated in any way other than with the puparium. This discovery was significant because here is calcium carbonate being eliminated constantly, even if in small quantities, into the wound and, because, as Beckhold (1929) has pointed out, calcium ions stimulate phagocytosis.

With this information at hand the next step in the problem was to find a way by which the leucocidin, excreted by the bacteria, might be controlled; because unless it could be eliminated rapidly, or rendered inert, the phagocytes would be killed about as rapidly as they appeared at the focus of infection. It seems possible, if not probable, that the maggots absorb through the intestinal wall, or the body wall, or both, this exotoxin given off by the bacteria and render it non-toxic in their bodies (such a phenomenon is not unknown in the animal kingdom) or that they ingest it and render it non-toxic in the alimentary canal through digestive processes. Coincidentally, with this treatment of the leucocidin the exuded calcium carbonate increases phagocytosis. Such a hypothesis, however, was of no assistance in furthering the investigation in search of chemical substitutes for living maggots. Therefore, it became necessary to develop a theory relative to the chemical nature of leucocidin in order to devise a way of rendering it inert. Speculation on this aspect of the problem led to the belief that the exotoxin might be protein in nature, i.e., a polypeptid or an amine and if so, a dilute aqueous solution of picric acid would readily render it insoluble and thereby inert. Admittedly, we are faced here with a hypothesis very difficult to prove, as is readily seen when one considers the difficulties of collecting any quantity of pure bacterial exotoxin and of identifying polypeptids and amines chemically. However, as we shall see later on in this paper, such a hypothesis is strongly supported by clinical evidence.

On the basis of the data and hypothesis mentioned, experimental treatments were started. Early experimentation showed the undesirability of using unmodified dilute aqueous picric acid solution (0.25 per cent) because of the relatively high surface tension which prevented the acid from gaining access to all of the crypts and crevices of the wound and thereby to all of the liberated leucocidin. This difficulty was easily met by adding enough glycerin to the solution to make an 8 per cent glycerin content, which reduces the surface tension to an entirely negligible quantity. Early therapeutic experimentation upon laboratory animals, guinea pigs, showed that when 0.25 per cent saturated aqueous solution of picric acid, containing 8 per cent glycerin, alone was used the progress was not especially marked, although there was some slow improvement. When an autoclaved aqueous suspension of calcium carbonate, 20 grams calcium carbonate to 215 cubic centimeters distilled water, was used alone considerable progress was noted, but this progress showed a very strong tendency to be superficial, indicating a possible unsatisfactory struggle between phagocytes and leucocidin. However, when the picric acid solution and the calcium carbonate suspension were used together progress was very marked and rapid in its course.

After the preliminary experimental treatments had been concluded, clinical work was started at the Jefferson Davis Hospital in Houston, followed later by work at Methodist Hospital, St. Joseph's Infirmary, and Hermann Hospital. The technique employed in administering this treatment to humans is very simple; there is nothing that cannot be

done by the average hospital nurse, after the surgery has been performed. This treatment, like both Orr's and Baer's, is postoperative, except in rare cases in which there is relatively free access to the focus of infection by means of spontaneous drainage sinuses. The necrotic bone is first removed surgically, the excavation being made long and as narrow as possible so that the strength of the shaft may be retained and because the cavity will close much more quickly when the granulating sides are not widely separated. Following the operation the wound is packed for 24 hours with vaseline gauze in order to allow the trauma to subside somewhat. At the end of this period, the vaseline gauze packing is removed and the wound is thoroughly irrigated with the picric acid glycerin solution by means of a syringe. This solution, with its reduced surface tension, quickly penetrates to every crypt in the wound and thereby gains access to the leucocidin and some of the bacteria as well. Usually no attempt is made to remove the picric acid solution from the wound and within a few seconds' time an aqueous suspension of calcium carbonate is sprayed into the wound by means of a nasal atomizer until a thin layer of precipitate is laid down over the osseous and soft tissues. A small quantity of the suspension will suffice for this purpose. The calcium carbonate combines with the picric acid solution to form calcium picrate.

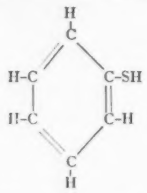


The action which takes place as a result of the introduction of these chemicals is very rapid and is that which is to be most desired when one contemplates the exact pathological conditions existing in osteomyelitis and the consequences of such conditions. The picric acid is given an opportunity to reach the greater quantity of the leucocidin and apparently acts upon it immediately. Then the calcium carbonate is added, forming calcium picrate, and the calcium ions are rendered available to stimulate phagocytosis. Also, as is well known, dead protoplasm is acid and any wound in which acid débris is allowed to remain suffers from a diminution of oxygen tension in the granulation tissue cells which in turn stimulates the autolytic enzymes contained within these cells to dissolve the surrounding protoplasm. Furthermore, acid causes a swelling of the tissue cells which pushes deeper into the bone canals the barriers that have been erected, thereby bringing about the deleterious consequences described at the beginning of this paper. The calcium carbonate controls this dangerous acidity by maintaining a neutral, or even alkaline, condition; the degree of which depends upon the condition of the wound and the amount of calcium carbonate present. It has been further observed, in every case treated, that the rate of drainage increases very rapidly, thereby inhibiting the dangerous pushing back, into the rigid bone, the defensive barrier as well as removing débris. Moreover, calcium picrate has very definite analgesic properties with consequent relief to the patient. After the calcium carbonate suspension is applied to the wound it is packed with dry gauze in order to prevent closure. When the foci of infection are very deep and it is impossible to reach them as described, the picric acid solution and the calcium carbonate suspension are applied through Dakin tubes with the ends cut off, or through male catheters, which are placed in the wound and packed in place with vaseline gauze, or they may be in some cases pushed down through the sinus tracts as needed.

Ordinarily these treatments are given three times a week, but in very severe acute cases they are usually given daily for the first week or two and thereafter three times weekly. The patient usually reports a "more comfortable feeling" after the very first treatment and in every instance improvement has been clearly observed in not more than a week after the first treatment. After the first week of treatment the drainage usually becomes less copious, the macroscopic and microscopic appearance of the exudate indicates improvement, bone destruction is arrested, and the soft tissue shows extremely healthy granulations. In passing, it might be pointed out that one of the most significant points in the contention that the calcium carbonate is the true active principle of the maggots is the type

of granulation tissue formed as a result of its introduction into the wound. The granulation tissue resulting from maggot introduction is of a smooth type and possesses a peculiar glistening sheen—such tissue appears to be specifically characteristic of maggot therapy. A macroscopically identical type of granulation tissue is immediately produced when calcium carbonate is applied to the wounds.

Frequently in cases of osteomyelitis of the tibia a sloughing of the soft tissue occurs after the wound has been granulating for some time. In an attempt to check this sloughing an aqueous suspension of thiophenol,



was applied to the wound with a cotton applicator. This suspension is made of 1 part thiophenol and 10 parts distilled water. The water is boiled before the thiophenol is added in order to eliminate the free oxygen. It is believed that the thiophenol aids the normal metabolism of the tissue by presenting sulphydryl groups which may function in the manner of glutathione. Superimposed upon this is undoubtedly the normal bactericidal effect. The results of this procedure are very striking; one, and at the most three, applications suffice to check the sloughing and granulation continues as before.

Table I is a summary of all of the cases treated by this new method. Before turning to this table a brief explanation of it is necessary. It was not always possible to determine the exact onset of the infection before admission because of the frequently faulty memory of the patients. The admission date, as recorded, refers strictly to admission to the osteomyelitis clinic or to treatment while the patient was still hospitalized. In regard to previous treatment, it should be pointed out that all cases, unless otherwise stated, were making no improvement or were getting worse under the previous treatment at the time of admission to the clinic to receive the picric acid calcium carbonate treatment. The lists of operations are admittedly incomplete in some cases because of poor memory on the part of patients and inaccessible records. It will be noted in this column of the table that operations performed before the initiation of the new treatment, as well as those performed afterward, are listed. The dates of disappearance of infection have been calculated most conservatively. The date recorded is that of 1 month after it was first believed that an infection no longer existed. During this month the patient was seen three times weekly and carefully observed for an infective process. Negative findings for this entire period indicated the determination of the date as stated above. In some cases it will be noted that the condition of the wound rather than a disappearance of the infection is reported over a date. These patients left the clinic and failed to reappear before the course of treatment was completed. The dates in these latter cases refer to the last time the patient was seen.

As indicated in Table I certain cases require more complete explanation.

Case 1. This case was apparently of long duration but no information of any value whatsoever could be obtained from the patient or his parents. On January 3, 1933, large swellings appeared on the lateral and medial aspects of the left upper arm. X-ray examination showed a well advanced and very active osteomyelitis of the left humerus. These foci of infection were apparently of long duration. On January 17, 1933, a large inflamed swelling appeared on the right upper arm and X-ray examination showed an active focus of infection of the right humerus; this focus also was well advanced. Thus it became obvious that the infection had become established throughout the body. Upon recommendation of radical surgical procedure, the patient left the clinic and failed to return. It is felt that, since the pathological condition of the patient was so far advanced and he was in such a weakened state, little or nothing could be done to alleviate the condition.

Case 2. This patient suffered a supracondylar compound fracture on June 14, 1932. It is believed that the onset of the infection dated nearly a month before the patient was referred to the osteomyelitis course of treatment.

Case 8. This case is of interest because of the probable luetic origin. In addition to the regular treatment a course of neosalvarsan was given.

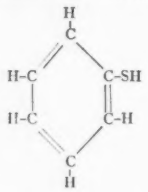
Case 10. This patient was treated from July 27, 1932, until October 10, 1933, with the picric acid glycerin solution only and progress was so slow

TABLE I.—SUMMARY OF CASE REPORTS

Case No.	Diagnosis*	Age	Onset before admission	Admission	Previous treatment	Operations	Disappearance of infection	Duration weeks
1†	Right femur	13	Indeterminate	10-20-1932	None	10-22-1933	Multiple infection developed. Femur greatly improved 1-19-1933	13
2†	Right humerus	21	Occured while in hospital	7-16-1932		Open reduction of fracture 6-6-1932	11-5-1932	16
3	Right tibia	47	10-19-1931	7-9-1932	Orr's	3-26-1932	9-20-1932	10½
4	Right femur	26	1-17-1932	6-13-1932	Orr's	3-1-1932	Greatly improved 9-27-1932	15
5	Third and fourth metatarsals	43	12-20-1932	12-30-1932	None	12-24-1932	4-1-1933	13
6	Right radius and ulna	29	6-15-1932	6-21-1932	None	6-21-1932	8-1-1932	6
7	Right tibia and fibula	14	3-10-1932	6-25-1932	Orr's		Very greatly improved 5-1-1933	44
8†	Left tibia, luetic osteoperiosteitis	19	10-1-1932	10-18-1932	None		Very much improved 11-26-1932	5½
9	Left tibia and fibula	43	12-23-1931	6-11-1932	Orr's	1-23-1932	3-15-1933	39½
10†	Left femur	18	3-1932	10-10-1932	Orr's Picric acid sol.	9-17-1932	2-1-1933	16
11†	Right second metatarsal, cuneiform, scaphoid, and cuboid	8	10-10-1931	7-16-1932	Orr's	10-20-1931 2-12-1932	10-1-1932	11
12†	Right tibia and fibula	6	5-15-1932	6-18-1932	Orr's	6-18-1932	7-11-1932	3
13	Right tibia	28	10- 4-1930	7-18-1932	Orr's	3-25-1932	10- 1-1932	11
14‡	Left tibia, astragalus, and calcaneous	13	8-31-1931	10-29-1932	Orr's	9- 7-1932 10-29-1932	12-16-1932	7
15	Brodie's abscess, left tibia	20	4- 5-1932	9- 3-1932	Arthretic	4- 4-1932	Very much improved 10-29-1932	8
16	Left great toe	47	11- 9-1932	12-20-1932	None	12-10-1932	2- 6-1933	7
17	Right first metatarsal	15	7- 5-1932	8- 7-1932	None	8- 6-1932	Practically disappeared 9-1-1932	3½
18	Right femur	27	3-1927	8-25-1932	Intermittent immobilization	7-30-1932 1- 7-1933	3-15-1933	29
19	Left radius and ulna	34	4- 9-1932	7- 9-1932	Orr's	3- 7-1932	12-31-1932	25
20	Right foot	21	6-21-1932	6-21-1932		6-20-1932	8- 9-1932	7
21†	Right tibia	37	7-31-1931	7-23-1932	Orr's maggots	10-24-1931 1-23-1932 6-11-1932	4- 1-1933	36
22	Right femur and left tibia	60	1914	6-25-1932	Orr's	1914 5-26-1932 6-25-1932 10- 8-1932 3-25-1933	Very greatly improved 5-15-1933	46
23	Left fibula	45	9-1925	3-28-1933	Orr's ultra-violet ray	9-1925 4-1926 12-1927 4- 1-1933	5-15-1933	7
24	Second phalanx second finger, right	36	11-15-1932	12- 1-1932	None		12-30-1932	4
25	Left femur	58	1921	3-16-1933	Orr's	1-23-1933	Only slight infection 5-15-1933	8½
26	Right femur	33	11- 1-1932	11-30-1932	None	11-26-1932	Greatly improved 1- 7-1933	5½
27†	Right tibia	29	3-10-1932	7-19-1932	Orr's	3-18-1932	No improvement 10-29-1932	14½
28	First metatarsal, left	54	4-16-1932	7-21-1932	Orr's	6-18-1932	8-20-1932	4

of granulation tissue formed as a result of its introduction into the wound. The granulation tissue resulting from maggot introduction is of a smooth type and possesses a peculiar glistening sheen—such tissue appears to be specifically characteristic of maggot therapy. A macroscopically identical type of granulation tissue is immediately produced when calcium carbonate is applied to the wounds.

Frequently in cases of osteomyelitis of the tibia a sloughing of the soft tissue occurs after the wound has been granulating for some time. In an attempt to check this sloughing an aqueous suspension of thiophenol,



was applied to the wound with a cotton applicator. This suspension is made of 1 part thiophenol and 10 parts distilled water. The water is boiled before the thiophenol is added in order to eliminate the free oxygen. It is believed that the thiophenol aids the normal metabolism of the tissue by presenting sulphydryl groups which may function in the manner of glutathione. Superimposed upon this is undoubtedly the normal bactericidal effect. The results of this procedure are very striking; one, and at the most three, applications suffice to check the sloughing and granulation continues as before.

Table I is a summary of all of the cases treated by this new method. Before turning to this table a brief explanation of it is necessary. It was not always possible to determine the exact onset of the infection before admission because of the frequently faulty memory of the patients. The admission date, as recorded, refers strictly to admission to the osteomyelitis clinic or to treatment while the patient was still hospitalized. In regard to previous treatment, it should be pointed out that all cases, unless otherwise stated, were making no improvement or were getting worse under the previous treatment at the time of admission to the clinic to receive the picric acid calcium carbonate treatment. The lists of operations are admittedly incomplete in some cases because of poor memory on the part of patients and inaccessible records. It will be noted in this column of the table that operations performed before the initiation of the new treatment, as well as those performed afterward, are listed. The dates of disappearance of infection have been calculated most conservatively. The date recorded is that of 1 month after it was first believed that an infection no longer existed. During this month the patient was seen three times weekly and carefully observed for an infective process. Negative findings for this entire period indicated the determination of the date as stated above. In some cases it will be noted that the condition of the wound rather than a disappearance of the infection is reported over a date. These patients left the clinic and failed to reappear before the course of treatment was completed. The dates in these latter cases refer to the last time the patient was seen.

As indicated in Table I certain cases require more complete explanation.

Case 1. This case was apparently of long duration but no information of any value whatsoever could be obtained from the patient or his parents. On January 3, 1933, large swellings appeared on the lateral and medial aspects of the left upper arm. X-ray examination showed a well advanced and very active osteomyelitis of the left humerus. These foci of infection were apparently of long duration. On January 17, 1933, a large inflamed swelling appeared on the right upper arm and X-ray examination showed an active focus of infection of the right humerus; this focus also was well advanced. Thus it became obvious that the infection had become established throughout the body. Upon recommendation of radical surgical procedure, the patient left the clinic and failed to return. It is felt that, since the pathological condition of the patient was so far advanced and he was in such a weakened state, little or nothing could be done to alleviate the condition.

Case 2. This patient suffered a supracondylar compound fracture on June 14, 1932. It is believed that the onset of the infection dated nearly a month before the patient was referred to the osteomyelitis course of treatment.

Case 8. This case is of interest because of the probable luetic origin. In addition to the regular treatment a course of neosalvarsan was given.

Case 10. This patient was treated from July 27, 1932, until October 10, 1933, with the picric acid glycerin solution only and progress was so slow

TABLE I.—SUMMARY OF CASE REPORTS

Case No.	Diagnosis*	Age	Onset before admission	Admission	Previous treatment	Operations	Disappearance of infection	Duration weeks
1†	Right femur	13	Indeterminate	10-20-1932	None	10-22-1933	Multiple infection developed. Femur greatly improved 1-19-1933	13
2†	Right humerus	21	Occured while in hospital	7-16-1932		Open reduction of fracture 6-6-1932	11-5-1932	16
3	Right tibia	47	10-19-1931	7-9-1932	Orr's	3-26-1932	9-20-1932	10½
4	Right femur	26	1-17-1932	6-13-1932	Orr's	3-1-1932	Greatly improved 9-27-1932	15
5	Third and fourth metatarsals	43	12-20-1932	12-30-1932	None	12-24-1932	4-1-1933	13
6	Right radius and ulna	29	6-15-1932	6-21-1932	None	6-21-1932	8-1-1932	6
7	Right tibia and fibula	14	3-10-1932	6-25-1932	Orr's		Very greatly improved 5-1-1933	44
8†	Left tibia, luetic osteoperiosteitis	19	10-1-1932	10-18-1932	None		Very much improved 11-26-1932	5½
9	Left tibia and fibula	43	12-23-1931	6-11-1932	Orr's	1-23-1932	3-15-1933	39½
10†	Left femur	18	3-1932	10-10-1932	Orr's Picric acid sol.	9-17-1932	2-1-1933	16
11†	Right second metatarsal, cuneiform, scaphoid, and cuboid	8	10-10-1931	7-16-1932	Orr's	10-20-1931 2-12-1932	10-1-1932	11
12†	Right tibia and fibula	6	5-15-1932	6-18-1932	Orr's	6-18-1932	7-11-1932	3
13	Right tibia	28	10- 4-1930	7-18-1932	Orr's	3-25-1932	10- 1-1932	11
14‡	Left tibia, astragalus, and calcaneous	13	8-31-1931	10-29-1932	Orr's	9- 7-1932 10-29-1932	12-16-1932	7
15	Brodie's abscess, left tibia	20	4- 5-1932	9- 3-1932	Arthretic	4- 4-1932	Very much improved 10-29-1932	8
16	Left great toe	47	11- 9-1932	12-20-1932	None	12-10-1932	2- 6-1933	7
17	Right first metatarsal	15	7- 5-1932	8- 7-1932	None	8- 6-1932	Practically disappeared 9-1-1932	3½
18	Right femur	27	3-1927	8-25-1932	Intermittent immobilization	7-30-1932 1- 7-1933	3-15-1933	29
19	Left radius and ulna	34	4- 9-1932	7- 9-1932	Orr's	3- 7-1932	12-31-1932	25
20	Right foot	21	6-21-1932	6-21-1932		6-20-1932	8- 9-1932	7
21†	Right tibia	37	7-31-1931	7-23-1932	Orr's maggots	10-24-1931 1-23-1932 6-11-1932	4- 1-1933	36
22	Right femur and left tibia	60	1914	6-25-1932	Orr's	1914 5-26-1932 6-25-1932 10- 8-1932 3-25-1933	Very greatly improved 5-15-1933	46
23	Left fibula	45	9-1925	3-28-1933	Orr's ultra-violet ray	9-1925 4-1926 12-1927 4- 1-1933	5-15-1933	7
24	Second phalanx second finger, right	36	11-15-1932	12- 1-1932	None		12-30-1932	4
25	Left femur	58	1921	3-16-1933	Orr's	1-23-1933	Only slight infection 5-15-1933	8½
26	Right femur	33	11- 1-1932	11-30-1932	None	11-26-1932	Greatly improved 1- 7-1933	5½
27†	Right tibia	29	3-10-1932	7-19-1932	Orr's	3-18-1932	No improvement 10-29-1932	14½
28	First metatarsal, left	54	4-16-1932	7-21-1932	Orr's	6-18-1932	8-20-1932	4

TABLE I.—SUMMARY OF CASE REPORTS—Continued

Case No.	Diagnosis*	Age	Onset before admission	Admission	Previous treatment	Operations	Disappearance of infection	Duration weeks
29	Right fibula	38	7- 1-1932	7-28-1932	None	10- 8-1932	2- 1-1933	27
30	Left tibia	37	9-17-1932	12- 1-1932	Orr's	10- 8-1932	Greatly improved 1- 5-1933	5
31	Right tibia and fibula	21	10-1929	6-25-1932	Orr's	4-19-1931 5-16-1931 3-12-1932 9-16-1932	2- 1-1933	31½
32	Great toe right foot	45	6-22-1932	7-19-1932	None	7-16-1932	9- 1-1932	6
33	Left tibia and fibula	31	5-1-1931	6-18-1932	Orr's	6-20-1931 9- 5-1931 1-22-1932	1-14-1933	30
34	Right tibia and fibula	39	11-23-1932	12- 3-1932	None		3-15-1933	14½
35	Left tibia	8	3-15-1933	4-29-1933	Orr's	3-24-1933	Greatly improved 5-18-1933	8
36	Left tibia and fibula	25	10-1930	12-20-1932	Orr's	12-10-1932	3-15-1933	12
37	Left calcaneous	17	3-21-1932	6-18-1932	Orr's	4- 9-1932 8-20-1932	12-15-1932	26
38	Right tibia and fibula	25	9-16-1930	6-11-1932	Orr's	9-18-1930 2-28-1931	Very greatly improved 11- 8-1932	21½
39	Right tibia and fibula	32	12-18-1932	1-15-1933	None	1- 7-1933 4- 8-1933 5- 5-1933	Very greatly improved 5-18-1933	13
40	Left tibia	32	2-15-1932	8-11-1932	None		11-15-1932	14
41‡	Left femur	13	7-1931	10-14-1932	Immobilization	10-14-1932 10-27-1932	5- 1-1933	28½

* These are all cases of osteomyelitis unless otherwise stated.
† Discussed further in text of paper.
‡ Irrigations through modified Dakin tubes or male catheters.

that only a very slight degree of improvement could be noticed at the end of the period. After the addition of the calcium carbonate suspension to the treatment, however, the rate of improvement was very markedly increased. These results substantiated the findings in the comparative treatments of guinea pigs described earlier in the paper.

CASE 11. This patient was improving under Orr's method of treatment but after the new treatment was begun the rate of improvement was very markedly increased.

CASE 12. This patient was progressing well under Orr's treatment but the increase in the rate of improvement after the new treatment was begun vividly impressed all of the observers who had been watching the case for some time.

CASE 21. As indicated in Table I, maggot therapy was tried in this case before administering the picric acid calcium carbonate. Five implantations of maggots were made into the wound but in each instance the maggots either left the wound or drowned because of very copious drainage. As will be described, such a difficulty is not infrequently encountered when maggots are employed in osteomyelitis wounds.

CASE 27. No improvement was noticed in this case after 14½ weeks of treatment. This failure can be easily explained by the fact that soft tissue had grown over the infected tibia and the patient would not permit an incision and curettement of the infected area thus allowing the chemicals to reach the focus of infection. This case constitutes the single failure in the entire series.

Three cases, not reported in Table I because at no time was the complete treatment administered, should be briefly discussed at this time.

CASE 42. Male, colored, aged 31 years, had osteomyelitis of the right tibia and fibula. Diagnosis was made September 15, 1931. He was treated by Orr's method from September 15, 1931, until June 18, 1932, with but little improvement. He was treated with calcium carbonate suspension from June 18, 1932, until September 20, 1932, with but very slight improvement. The wound would appear to be healing and would then break down again.

CASE 43. Female, white, aged 46 years, had an osteomyelitis of the left tibia. Diagnosis was made February 10, 1932. She was treated from February 10, 1932, until June 4, 1932, by Orr's method, with no noticeable improvement. She was treated with calcium carbonate suspension alone from June 4, 1932, until December 20, 1932. Some improvement in original focus of infection was noted but the

spread of the infection throughout the length of the shaft was not checked.

CASE 44. Male, colored, aged 21 years, had a staphylococcus pyogenes aureus infection in the soft tissue on the dorsum of the left foot. Diagnosis was made July 14, 1932. He was treated with picric acid glycerin solution alone from July 14, 1932, until December 20, 1932. It is readily seen that the rate of progress was very slow. It is quite certain that such would not have been the case had the calcium carbonate suspension been administered in addition to the picric acid solution, in view of the experience in those cases in which the complete treatment was given.

These 3 cases serve to substantiate the findings of the comparative treatments upon the guinea pigs. Apparently the picric acid, while caring for the greater part of the leucocidin, does not kill all of the bacteria present; and the calcium carbonate, while increasing phagocytosis cannot do this at a sufficient rate to overcome the effects of the uncontrolled leucocidin; whereas in the complete treatment, the picric acid controls the leucocidin, thus enabling the stimulated phagocytes to care for the bacteria.

From this preliminary report, and any report of an investigation of the treatment of an infection of this sort which has not been conducted over a period of several years must necessarily be preliminary, certain conclusions can be drawn. If we compare Table I with the table given by Kulowski (1931) in his paper reporting 155 cases of osteomyelitis treated by Orr's method, we are immediately impressed by the shorter duration of treatment required by the method reported in this paper. There is, furthermore, at the most, not more than 50 per cent as much scar tissue formed when this treatment is used as when Orr's is employed, which, of course, means much greater subsequent function of the afflicted member and a greatly decreased possibility of subsequent breaking down of the poorly nourished fibroid tissue. Also the picric acid calcium carbonate treatment requires a very much decreased degree of immobilization with consequently increased circulation and greater comfort for the patient. The postoperative technique employed in the new treatment is much simpler than in Orr's treatment and the expense to the patient is decreased. Finally, as will be discussed in a later paragraph, Orr's treatment is far from satisfactory in very many respects and many orthopedists are beginning to see fallacies in the theory advanced to support it.

If we attempt to compare the treatment described in this paper with Baer's method we find several factors which lead us to believe that the new treatment is the better of the two. This statement is not based alone upon rather extensive personal experience with the employment of maggots but upon criteria which Baer (1931) himself used in reporting his treatment of 89 cases. From Baer's report and tables we see at once that the picric acid calcium carbonate treatment effects healing even more quickly than do maggots. Furthermore, there is no danger of introduced contamination as there is in maggot therapy. The patient suffers no discomfiture as he does from the scavenging activities of the maggots, but benefits instead from the analgesic properties of the calcium picrate. The expense is only a small fraction of that of maggots and the patient is filled with no feeling of disgust. The new treatment, moreover, can be used in cases in which there is excessive drainage, which is actually beneficial, whereas in maggot therapy such drainage is definitely inhibitory. The patient is invalided to no greater degree than by Baer's method and while the dressings are a trifle more frequent the total labor involved is very much less. While it has been demonstrated by clinical experience that this type of treatment is not to be preferred over maggots in wounds in which a great deal of necrotic tissue is present and cannot be removed surgically; it has also been demonstrated that in all other types of osteomyelitis wounds the picric acid calcium carbonate treatment is to be preferred. In deep infections, such as hip infections, maggots cannot be successfully used, but the new treatment can be employed, by means of modified Dakin tubes or male catheters, very easily and effectively. Furthermore, whereas maggots are indicated when there is an abundance of necrotic tissue, after a certain stage of progress has been attained and most, if not all, of the necrotic débris has been removed, they hinder, rather than aid, the final healing process and at this stage the chemicals men-

tioned above have been applied with most satisfactory results in a number of cases.

CRITIQUE OF OTHER METHODS OF TREATMENT

Before concluding this report it seems appropriate to offer brief critiques of the various treatments of osteomyelitis now in vogue.

Maggot therapy has been discussed briefly and compared with the picric acid calcium carbonate treatment in the preceding section but it seems advisable to consider it in a little more detail and in comparison with other methods of treatment. Recovery is more rapid than when Orr's method is used, if we are to accept the case histories which have been published and those which many of us have observed. There is very little scar tissue formed as compared with the amount formed when Orr's method is employed, and there seems to be but very little danger of a recurrence of the condition. These three factors are of great importance. In addition, is the fact that the patient need not always be placed in a circular cast and thereby decrease the circulation and invalid the patient to a high degree. Where immobilization is necessary, or advisable, it can usually be satisfactorily effected by means of a posterior splint or a sugar tong splint when maggots are employed. The factors antagonistic to maggot therapy must, however, be seriously considered. In the first place there is the ever-present necessity of securing absolutely sterile maggots. This is not always easy, because when pharmaceutical supply houses recommend that anti-tetanus serum be given the patient coincidentally with the application of the maggots they thereby admit the doubt in their minds as to the sterility of their product. Failure to heed the sterility requirement invites disaster. Not tetanus bacilli alone but other pathogenic bacteria as well may be introduced into an already weakened system by contaminated larvæ. Recently a paper appeared in a medical journal in which an orthopedist stated that he is employing unsterilized maggots in the treatment of osteomyelitis and at the time of the first implantation he is inoculating the patient with anti-tetanus serum. Such practice is direct abuse of a new therapy. The technique employed is dangerous and may lead to extremely serious results. A feeling of disgust is frequently created in the mind of the patient when he contemplates living maggots working in his body tissues and as a result he often offers strong opposition to the recommendation of his physician to use these organisms. Another argument against the routine practice of maggot therapy, based upon personal clinical experience, is that at times, no matter how favorable the condition of the wound may be for the application of maggots, the treatment is contra-indicated because of the nervous condition of the patient. Patients have been observed under this treatment in whom the nervous results, due to the pain sometimes accompanying the activities of the maggots, the feeling of disgust in the patient, and a vivid imagination, were such that it seems certain the patient would have been better treated by some other method. The pain involved by the maggots' scavenging work is a factor to be considered but, fortunately, is usually of little importance. The introduction of maggots into wounds where there is copious uncontrolled drainage is absolutely futile because the maggots will either drown or leave the wound because of oxygen deficiency. We may critically and scientifically conclude that in maggot therapy we have an extremely useful thing but something which has sharply defined limits to its application and must not be abused. For example, when unsterilized maggots are used and when maggots are used on pathological conditions without regard to the stage of progress or etiology the assumption may be safely made that only failure and disrepute will follow. The conclusion presented in the previous paragraph may here be repeated: where there is a relatively large amount of necrotic débris present in a reasonably shallow wound initial treatment with maggots is indicated, but where the amount of necrotic tissue is not relatively great, in deep wounds, and after the maggots have removed the greater part of the results of necrosis (with infection still persisting) the picric acid and calcium carbonate treatment is to be preferred.

Orr's method has been widely used in the treatment of osteomyelitis for several years,

and every observer must admit that the results have been far from satisfactory. The duration of treatment is usually long and the incidence of recurrence is entirely too high. There is a great deal of scar tissue formed during this type of treatment. Such an amount of scar tissue as is frequently, if not usually, formed as a result of this therapy, of course, spells a high degree of loss of function and too great a possibility of recurrence due to the breaking down of this poorly nourished fibroid tissue. A point of doubt in the minds of many is the theory upon which Orr's method is largely based, i.e., the action of a bacteriophage upon the pathogenic organisms. This doubt is very well founded as will be shown in a later paragraph where the treatment of osteomyelitis with phage is discussed. It may be pointed out here, however, that phage respires during its lysis of bacteria; such lysis occurs much more slowly in test tubes in which the oxygen tension is low than in those in which it is high, and obviously in a wound tightly packed with vaseline little respiration can occur. Furthermore, while phage is not infrequently found in a wound it is usually not lytic to the wound bacteria since purulent material, exudate, blood, and diluted serum, all of which are retained to a very high extent in the wound under Orr's treatment, are inhibitory to the destructive action of phage, even in dilutions of 1:1000 as shown by Applebaum and MacNeal (1931). The advocates of Orr's method admit the prime importance of adequate drainage but as Hawk (1933) writes: "But for adequate drainage to be secured in a rigid bone plugged with vaseline, a substance non-miscible with water, and the part then enclosed in a plaster cast for an indefinite period, is more than the writer's imagination can encompass!" Orr (1927) strongly emphasized immobilization and the proponents of his therapy religiously follow this practice. Hawk (1933) again writes: "We have emphasized that bone tissue is rigid to the *n*th degree, the only alteration that an enclosing plaster case can accomplish is to render the circulation more sluggish, and thus to interfere with healing. We advise getting the patient on his feet as soon as he has recovered from the mechanical work in the operating room, provided enough bone has been left to support the limb. Bone is viable tissue, and living tissue increases its vitality with use. Not all of the bone is diseased, and the resistance of the viable part to the infection will be raised by use. Using a bone increases the blood flow, mobilizes calcium, and stimulates the part to meet the demands placed upon it. The X-ray shows absorption of calcium after one week in a limb that is immobilized for any cause, and this proves the delicate balance, to which bone is sensitive, between use and non-use. It has been found by animal experimentation that ligating return veins in cases of arterial damage lessens the frequency of gangrene in the limb. Intracapillary tension is necessary for proper nutrition and the use of a limb in a dependent position increases both the blood pressure and the hydrostatic capillary pressure. When one views a patient lying in bed week after week, with the involved part enclosed in a cast, and absorbing putrefactive products from the wound, with a sluggish circulation from no exercise, one is not surprised to see him sallow and toxic in appearance, and what little appetite he may have diminished by a foul stench! The author has seen this picture only too often; the wonder is that the patient gets well at all." It is felt that one should strongly hesitate before recommending such a treatment as described by Orr for osteomyelitis and this feeling is well substantiated by the facts heretofore presented.

Albee (1933) has recently published a paper on the treatment of osteomyelitis by bacteriophage in which he recommends the filling of the osteomyelitis wound with a paraffin-vaseline plug and then introducing the bacteriophage into the wound, through catheters fixed in the plug, over a period of 6 months, at the end of which time recovery is claimed. In the preceding paragraph certain facts were pointed out as being inhibitory to phage activity and among the chief of these is the plugging up of the wound. Also, of course, such plugging inhibits drainage. Anyone familiar with bacteriophage and bacteriophagy finds serious doubt arising in his mind over such a suggestion as this of Albee. The hopes of such a method of treatment being successful

can only be very slight in view of the following known facts, in addition to those previously presented, of the phenomenon in question. In the first place, lysis of bacteria is a secondary phenomenon which may or may not follow the accumulation of phage, depending on the conditions of the environment. These conditions of environment are principally the presence of old bacteria, colloids of tissues, and colloids of body fluid; it is a well known fact that bacteriophage is adsorbed on such bodies and thereby inactivated. In the second place, phage can be present for months without manifesting itself, or becoming active, because the bacteria are, for some as yet unknown reason, resistant to it during this period of time. In the third place, phage introduced into the body is usually entirely eliminated in from 24 to 48 hours. This elimination of bacteriophage cannot be counteracted by increasing the therapeutic doses because of the toxicity of phages. In the fourth place, repeated administration of moderate amounts of phage over a long period of time, as Albee advises, is inadvisable because of the development of anti-phage which abolishes all phage action. It may be pointed out here, also, that under conditions existing *in vivo* the susceptible bacteria, as distinct from the resistant forms, are not subject to lysis as freely as they are *in vitro*. We may conclude from our present knowledge of phage that the hope of utilizing bacteriophage as an agent for prevention and therapy of infection lies in finding the means of removing the obstacles to its activity in its natural environment and allowing it to act as freely as it does in test tubes. As yet we have no idea how this may be done. These arguments are not only in disfavor of Albee's method but, of course, of the method of Orr as well.

Hawk (1933) has proposed the packing of osteomyelitis wounds with gauze well impregnated with a paste made of one part glycerol and two parts of magnesium sulphate. His treatment is based upon the principles of increasing the exudation from the wound by the high exosmotic action of the magnesium sulphate and of using a solute, magnesium sulphate, having a high valence and active ionization for the precipitation of colloids and destruction of bacteria. It should be pointed out here that magnesium sulphate acts as a narcotic upon tissue cells and thereby retards phagocytosis while calcium ions stimulate the phagocytes. Also the very osmotic pressure of which Hawk writes not only increases the rate of drainage but very seriously dehydrates phagocytes and granulation tissue, thus bringing about a very abnormal condition in the healing tissue as well as killing the phagocytes. This action is continuous inasmuch as the wound is packed with the chemical. From Hawk's paper one may infer a belief on his part that bacteria are definitely eliminated from the wound by the increased amount of exudate. This is not necessarily so inasmuch as they may be deposited anywhere and, since magnesium sulphate is not an effective bactericide, continue to thrive. Whereas in the picric acid calcium carbonate treatment while some of the phagocytes may be killed off, as many of the bacteria are, by the picric acid solution they are nevertheless immediately stimulated again upon the addition of the calcium carbonate to the wound. Hawk emphasizes the serious effects of the acid nature of the wound and yet this acidity is not diminished in the slightest and is probably slightly increased by the magnesium sulphate since this substance is slightly acid. In the case of the addition of calcium carbonate the acid is controlled and a neutral or slightly alkaline condition is maintained in the wound. Finally, there is no advantage to be gained by the partial absorption of magnesium through the wound. It appears to be highly probable that magnesium could be found in the urine of the patients who were being treated by this method.

The writer wishes at this time to express his deep appreciation to those men without whose generous cooperation the investigation which is reported in this contribution could not have been accomplished. Dr. G. Holmes Richter of the Rice Institute has constantly served in the capacity of a chemical adviser and has contributed many very valuable suggestions in the furtherance of the work. Drs. F. C. Bishopp and G. F. White of the U.S. Bureau of Entomology kindly supplied the maggots with which the work was started. Dr. James R. Bost first made it possible for clinical investigations to be carried on at the Jefferson Davis Hospital and has given freely of his time. Dr. A. N. Boyd has been of invaluable assistance in directing the clinic and in constantly helping with the work at Jefferson Davis Hospital during the entire course of the

investigation, in aiding in the analysis of case histories, in offering a great many valuable suggestions, and in constantly encouraging and promoting the work in every possible way. Dr. B. T. Van Zant has constantly and cheerfully assisted in the interpretations of X-ray plates. Dr. J. M. Mitchner gave his complete co-operation during his period of service as chief of the orthopedic section at the Jefferson Davis Hospital and also at the same hospital Drs. H. J. Ehlers and L. Ewing Bush contributed valuable surgical and clinical assistance. Finally, but by no means least, an expression of deep appreciation is due Dr. Joe B. Foster for rendering available clinical facilities at St. Joseph's Infirmary and at Methodist and Hermann Hospitals, for arranging for opportunities to use Dakin tubes in introducing the chemicals into deep infections, for countless valuable suggestions, for cheerfully and generously giving his time in assisting in many of the details of the work, and for his constant encouragement.

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CONTUSION OF CARTILAGE AS AN ETIOLOGICAL FACTOR IN CHRONIC ARTHRITIS[1]

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DURING the past year I have operated upon two patients with progressive arthritis in one knee joint in which the arthritis appears to have been the result of a contusion of the articular cartilage. I wish to report these two cases and discuss the condition.

CASE 1. W. C. S., iron worker, aged 37 years, was examined on June 3, 1932. Patient complained of pain and disability in the left knee. On January 11, 1932, patient jumped a distance of about 2 feet and struck the left knee on the edge of an iron beam. He experienced severe pain in the knee and within a few hours it was swollen and stiff. He was treated by radiant heat and the symptoms subsided to a point where he is now able to walk without support and experiences no pain or disability after walking several blocks. However, he states that the joint is stiff in the morning and that it becomes stiff after sitting for a half hour or so, and if he attempts to do heavy work or engages in an unusual amount of exercise the knee becomes sore and swollen. At no time has there been any sensation as of something catching or slipping in the joint, but the knee feels weak and on two occasions has given way under him.

On physical examination there was found a slight thickening of the left knee with some loss in the normal contour of the joint. There was definite tenderness on deep pressure just lateral to the patellar ligament and slightly proximal to the joint line. With the knee flexed the area of maximum tenderness appeared to be proximal to the external semilunar cartilage. There was no excess fluid in the joint. There was moderate soft crepitus on motion, but this was also present in the right knee. The ligaments were intact. Movements of the joint were slightly limited in that there was about five degrees more extension of the right than of the left knee and when extension of the left knee was forced the patient complained of pain deep in the knee beneath the patellar ligament and he experienced similar pain when the knee was forcibly flexed. There was slight atrophy of the muscles of the left thigh. The roentgen ray revealed no pathology.

Diagnosis was traumatic arthritis of the left knee with contusion of the articular cartilage of the external condyle of the femur. The diagnosis of cartilage contusion was based on the patient's statement that the part of his knee which struck the beam corresponded to the tender area over the lateral condyle of the femur.

I advised an elastic bandage, graded exercises, and hot compresses to the knee. As the symptoms did not improve, but became a little more severe, I explored the knee on February 1, 1933, expecting to remove the lateral half of the fat pad and the external semilunar cartilage. With the knee flexed the external semilunar cartilage was exposed through an L-shaped incision.

When the joint was opened, slightly more than the usual amount of synovial fluid escaped and this fluid was slightly yellowish in color. The fat pad appeared to be enlarged and the synovial membrane was definitely thicker and more vascular than normal. The semilunar cartilage appeared to be normal. I removed the semilunar cartilage and the lateral half of the fat pad, but was not satisfied that I had found enough pathology to explain the patient's symptoms. Consequently, I extended the incision upward and found a hyperplastic synovial fringe extending upward, lateral to the patella. This was removed. When the lateral condyle of the femur was examined an area of the cartilage was seen to be softened and velvet-like in appearance. This area was roughly circular in outline, about 2 cubic centimeters in diameter and was located on the anterior and proximal portion of the surface of the condyle corresponding to the part of the knee which the patient stated had received the impact of the injury. The damaged cartilage was dull white in color and was fibrillated and its margins merged into the normal cartilage around it. The damaged area was excised with a knife and gouge, exposing the subchondral bone, and the knee was closed.

The convalescence was uneventful and within 8 weeks the patient could snap his knee into full extension or forcibly flex it without pain, and he now believes that he has been permanently relieved, but I have warned him not to expect a normal knee.

CASE 2. A truck driver, aged 39 years, examined on March 20, 1933, complained of pain and disability in the right knee. On September 7, 1931, the patient slipped and fell on a concrete floor striking the anterolateral portion of the right knee on the floor and twisting the right leg under him. There was severe pain in the knee and it became swollen. The roentgenogram showed a slight fracture of the lateral condyle of the tibia with no displacement of the fragments. The knee was aspirated and he remained in the hospital 2 weeks and was sent home with the extremity in a plaster cast. This was removed in about 4 weeks. As the pain and disability continued his doctor explored the knee on March 15, 1932. Through a long median patellar incision, the fat pad which was large and the internal semilunar cartilage ("which looked to be somewhat loose on the inner margin") were removed. Convalescence was painful, and swelling, disability, and limitation

[1]Presented at the meeting of the American Committee for the Control of Rheumatism, Milwaukee, June 12, 1933.

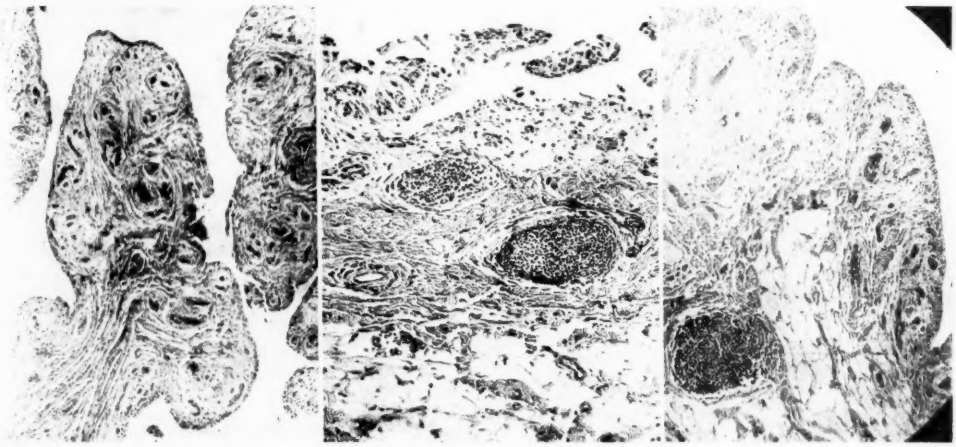

Fig. 1. Synovial membrane from Case 1 showing villus formation, increased vascularity, and nodules of small round cells.

of motion persisted. In May, 1932, a plaster cast was applied for 3 weeks and he was then given a brace and in October, 1932, the knee was manipulated, but the pain persisted and the knee became swollen after walking 6 or 8 blocks.

Physical examination revealed the right knee moderately swollen and the normal joint contour obliterated. There was some excess fluid in the joint and there was definite thickening of the periarticular tissues and the joint was quite tender, especially over the middle third of the old operative scar mesial to the patella and over the anterior end of the external semilunar cartilage. Flexion was limited to 70 degrees and motion of the joint elicited marked, rather coarse crepitus. There was considerable pain at the limits of flexion and extension when these motions were slightly forced. The lateral and crucial ligaments were intact.

Diagnosis was severe traumatic arthritis with probable old injury to the external semilunar cartilage. I advised synovectomy and removal of the external semilunar cartilage.

On April 4, 1933, the right knee was opened through a vertical incision lateral to the patella. When the joint was opened about 20 cubic centimeters of rather dark, straw colored fluid escaped. This fluid contained a few flakes of fibrin. The synovial membrane was markedly thickened and more vascular than normal and the fat pad was larger than normal. The external semilunar cartilage appeared to be normal. The margins of the articular cartilage were slightly invaded by the hyperplastic synovial tissue. On the external condyle of the femur there was an area about 2.5 centimeters in diameter in which the articular cartilage was softened and fibrillated. The cartilage over this area was split by numerous clefts and for the most part appeared to be dead and degenerating, but a large number of small, slender villi arose from this area and projected into the joint cavity. The longest of these was over 2 centimeters long and their presence on the surface of the condyle gave this area a shaggy appearance. These villi appeared to be composed of living cartilage or dense connective tissue. The cartilage covering the articular surface of the patella was also softened and fibrillated and appeared to be degenerating. The area of degenerating cartilage was removed from the lateral condyle of the femur and practically all of the cartilage on the articular surface of the patella was removed. The external semilunar cartilage, fat pad, and synovial membrane were removed from the lateral portion of the joint and through a vertical incision mesial to the patella the synovectomy of the anterior portion of the joint was completed.

The convalescence was uneventful and the patient states that the joint is much more comfortable than it has been at any time since the injury and he is now walking without support and with no pain, but flexion is limited to 110 degrees.

Microscopic examination of the articular cartilage from Case 1 showed necrosis of the surface of the cartilage with some fibrillation, and death of the cells in the tissue adjacent to the clefts in the cartilage. The synovial surface presented many small folds and villi and the cells were moderately increased in size and number. The subsynovial tissue was more vascular than normal and was moderately infiltrated with small and medium sized round cells and the sections examined contained several small, compact nodules of small round cells.

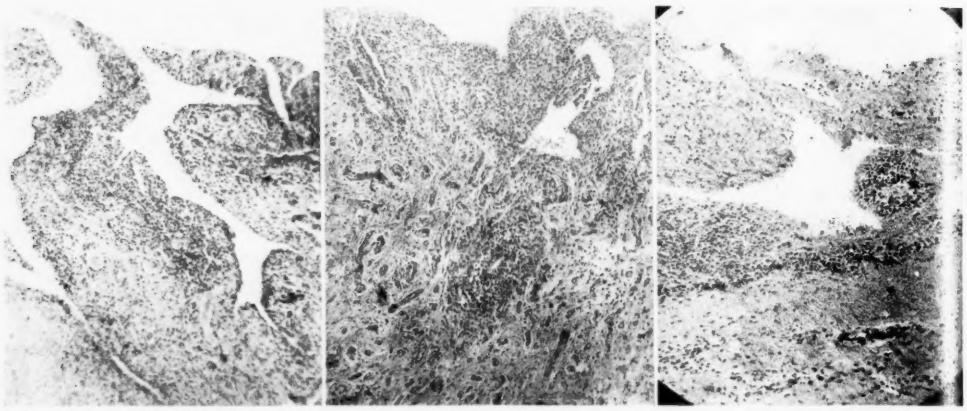

Fig. 2. Synovial membrane from Case 2 showing villus formation, synovial hyperplasia, and infiltration of the subsynovial tissues. Photomicrograph on the right shows fibrin in the joint cavity and adherent to the surface.

The articular cartilage from Case 2 was also necrotic and degenerating and its surface was broken by numerous clefts, some of which extended down to the zone of provisional calcification, but it contained many areas in which the cartilage cells were increased in size and number and had formed small cell nests. The villi which sprang from the articular surface were composed of an avascular tissue which resembled both hyaline cartilage and connective tissue. The stroma was, for the most part, hyaline, but the cells resembled small connective tissue cells and near the apices of the villi the cells were so numerous that the cartilaginous character of the tissue was lost.

Cultures from the first case were negative, but staphylococcus albus was grown from a piece of the synovial membrane removed from Case 2. I attempted to confirm this finding, but bloody fluid aspirated from this joint one week after operation was sterile; so it is probable that the first culture was contaminated.

Upon searching the literature I find that the belief that contusion of the articular cartilage may result in chronic progressive arthritis of the injured joint is not a new one. Budinger reported 14 cases in which he had operated upon the knee for symptoms which dated from an injury and in which he had found evidence of injury to the articular cartilage. The injured cartilage was excised with a knife and the patients were completely relieved or markedly improved after the operation. In 2 of these cases the lesion was limited to the articular surface of the patella and in 2 there was also a lesion on the external condyle of the femur. Budinger found that the cartilage was split in an irregular manner, and in some instances smaller clefts radiated from the larger ones while in others the cartilage adjacent to the margins of the clefts was loosened from the underlying structure and had assumed a flap-like appearance and in 1 recent case there was a hæmorrhage beneath the articular cartilage. He also noted that the synovial membrane and fat pad were thickened in many of his cases. Budinger concluded that traumatic splitting of the cartilage is the most frequent injury of the knee joint and that many cases heal spontaneously, but that in a certain percentage functional disturbances develop (when the cartilage flaps are elevated, when the clefts are wide and a chondritis develops in their vicinity, or when a part of the cartilage is set free in the joint). He described the clinical picture, but stated that the diagnosis could be made only by an exploratory operation, and he recommended excision of the injured cartilage.

Ludloff reported a similar case in 1910 and Axhausen reported 1 case in 1922. Laewen reported 13 cases and his conclusions were similar to those of Budinger, but he went a little further and considered the removal of the injured cartilage as an early operation for

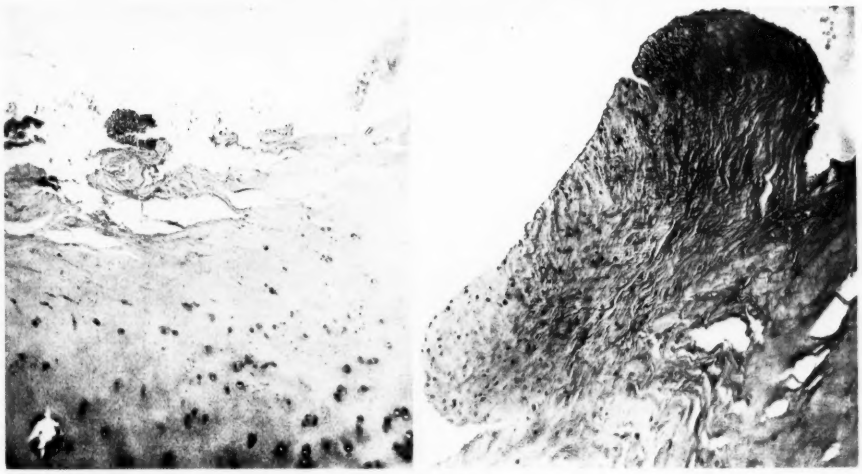

Fig. 3. Cartilage from Case 2. Left, surface degeneration with fibrillation. Right, surface proliferation and fibrosis forming a small sessile villus.

arthritis deformans. Koenig stated that he had operated upon 7 similar cases and agreed with Laewen in that the operative removal of the fissured cartilage was a prophylactic measure in the prevention of arthritis deformans.

When I operated upon these two patients I was not familiar with the German literature on the subject and was very hesitant about excising the areas of damaged cartilage, because I have always treated this tissue with great respect and in operations upon joints have meticulously avoided injuring the articular cartilage in any way. I have even reported experiments in which the resection of a relatively large rectangle of cartilage from the patellar surface of the femur of rabbits resulted in a progressive arthritis in about sixty per cent of the operated knees (Key).

Consequently, I had no desire to perform the same experiment on a man, but there seemed no alternative as the cartilage in the damaged area was necrotic and the necrosis seemed to be apt to spread.

Furthermore, Dr. Walter Bauer had not been able to confirm my experimental results on rabbits (personal communication) and I had also found that removal of a rectangle of cartilage from the patellar surface of the femur in cats did not cause arthritis and that similar operations on dogs resulted in mild hypertrophic changes in only an occasional animal. Consequently, I hoped that the defect would heal with a fibrous or cartilaginous base and that a progressive arthritis would not develop in the knee. In the second case I was much more radical, partly because of my experience with Case 1 and partly because the knee was so badly damaged that all I hoped to obtain was a stable, painless joint with about 60 degrees of motion.

Six years ago I removed an old chronic internal semilunar cartilage from a young surgeon. The anterior end of the cartilage was torn and enlarged to about three times its normal size. On the condyle of the femur opposing the knob-like end of the torn semilunar there was an area about 1.5 centimeters in diameter in which the articular cartilage was thinned, roughened, and velvet-like in appearance, but not gray and necrotic. Recently I questioned this patient and he states that he has had no trouble with the knee since recovering from immediate effects of operation.

It is thus evident that a joint may return to an apparently normal condition after a contusion and gross injury to the articular cartilage. On the other hand, the two cases which I am reporting in this paper indicate that such an injury may lead to a chronic

progressive arthritis and in looking back I can recall other cases in which I believe an arthritis resulted from a contusion of the articular cartilage. Why one patient develops a chronic arthritis while another has no symptoms after a similar anatomical lesion, I do not know.

Kulowski has reported three similar cases which were relieved by removal of the injured cartilage.

CONCLUSIONS

Contusion of the articular cartilage may heal without symptoms or may lead to a chronic arthritis in the injured joint.

When arthritis follows such an injury the joint should be opened and the degenerating cartilage should be excised.

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CLINICAL SURGERY

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RADICAL EXCISION OF THE BREAST

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THE operation for radical removal of the breast and its associated structures as practiced for malignant disease has become a standardized procedure. Opinions may differ on certain details of extent and technique, but, taken as a whole, there is a considerable measure of uniformity, and in general the principles are accepted that the operation to be effective shall include removal of (1) a skin area which includes the nipple, plus a sufficiency of the same tissue overlying the tumor; (2) the subcutaneous tissue covering the chest wall, the mammary gland forming the center of the subcutaneous area ablation; (3) the greater and lesser pectoral muscles, with the exception of the uppermost fibers of the former muscle, where they pass from the front of the inner two-thirds of the clavicle; (4) the fascial structures in relation to the lateral chest and upper abdominal areas; (5) the various groups of lymphatic glands which lie in association with the mamma, and to which malignant cells may be borne.

A summary of this kind indicates that the operation is one of considerable extent, and so in fact it is, yet the mortality is surprisingly small, and with reasonable care there are virtually no complications to mar the postoperative progress of the case.

INDICATIONS FOR OPERATION

In general it may be said that the indications for operation are such breast diseases as are definitely malignant, or which show a histopathology of a borderline type. It is true that there are cases in this category which are treated by radium or by X-ray therapy, but the majority of surgeons will agree that the results of the radical operation for malignant disease are so good that the procedure is likely to remain the method of choice for some considerable time to come. If we are to look at the question from the point of view of contra-indication to the radical operation we may say that there are only two contra-indications—the extent of the tumor, whether local or by metastases, and the general condition of the patient.

PRE-OPERATIVE DETAIL

Apart from the preparation which is common to all operative interference of a major nature, there are one or two details of special significance in breast surgery. The first concerns the question of case investigation, and it is that care should be taken to extend the examination beyond the breast and its related parts, and to bring under review by radiographic and clinical examination the condition of the mediastinum, the vertebral column, and the abdominal area. In certain instances these areas are the sites of secondary deposits at a comparatively early stage in the history of the case, and it is obvious how unfortunate the position would be if their existence were overlooked.

The second detail is in relation to the matter of skin preparation. Because of the difficulty in securing a satisfactory sterilization of the axillary skin, all breast cases demanding the radical operation should undergo a careful skin sterilization over a period of 48 hours prior to the operation, special attention being paid to the preparation of the axillary area. Similar care is demanded in that part of the preparation which immediately precedes the operation. The skin incision is an extensive one, a relatively large amount of tissue area is exposed to the possibility of infection, and peculiar care must, therefore, be exercised in securing a widespread and thorough skin disinfection. It is advisable to prepare an area which extends from the base of the neck to the umbilicus, and from the nipple of the opposite side to the line of the vertebral column.

THE OPERATION TECHNIQUE

The patient lies on her back with the head and shoulders slightly raised. In order to open up the axilla the arm of the affected side is abducted

Fig. 1. The outline of the skin incision as employed when the disease occupies a central position in the breast.

until the hand is above the level of the head, the arm being held in this position by an assistant. In order to lessen the amount of soakage which is likely to accompany the operation, a roll of sterile wool covered with a gauze towel is placed beneath the axilla and behind the lateral surface of the chest wall.

The type of skin incision will vary according to the situation and the extent of the tumor, but in the majority of cases the most suitable incision is one which crosses the center of the axilla postero-anteriorly, and thence extends obliquely downward across the breast to beneath the costal margin on the opposite side, separating at its center so as to include the nipple and a sufficiency of skin overlying the tumor (Fig. 1). In order to lessen the possibility of surface recurrence a wide area of cutaneous tissue should be removed, and it is our practice to extend the incision a distance of at least 5 centimeters beyond the outermost limit of the tumor area. It may be said that this will result in inability to close the wound in a proportion of the cases, but it is infinitely preferable to leave an open surface which will close by granulation or by grafting than to invite the likelihood of a skin recurrence.

Dissection of the axilla. The skin incision having been outlined in a superficial fashion, that portion of it which overlies the axilla and the anterior axillary wall is deepened, and the edges reflected so as to afford access to the axilla and its contents. It is our practice to complete the axillary dissection up to a point before removing the breast and pectoral muscles, for the reasons that such a procedure permits a block dissection by which glands, fascia, and muscles are removed in continuity, the vascular supply to the muscles is more easily and efficiently controlled, and the removal of the pectoral muscles (the portion of the operation which entails the maximum amount of shock) is delayed until the end of the procedure.

The edges of the axillary portion of the incision having been reflected, the boundaries of the base of the axilla are brought into view, and by sharp dissection these boundaries are revealed as the lower edge of the pectoralis major anteriorly, and the lower edge of the latissimus dorsi posteriorly. The base of the axilla space is covered over by the axillary fascia, and this is pierced by the finger immediately behind the boundary of the great pectoral muscle. The dissection is now carried to a higher level. By separation and retraction of that portion of the skin incision which passed over the pectoral muscle the line of separation between the clavicular and sternal fibers of the muscle is defined. Opening up the separation by retraction the costo-coracoid membrane comes into view, and, coursing over its center in a vertical direction is the leash of the acromiothoracic (thoraco-acromial) vessels, accompanied by the external anterior thoracic nerves. These structures enter the deep surface of the pectoralis major muscle, and at this stage it is convenient to divide the vessels between ligatures and to sever the nerves (Fig. 2).

The finger of the operator is now passed through the plane of separation and beneath the pectoralis tendon until it appears in the axilla. The segment of muscle thus isolated is divided close to its insertion into the outer lip of the bicipital groove of the humerus, and retraction of the central divided end affords a partial exposure of the anterior aspect of the axilla (Fig. 3). The pectoralis minor and the outer half of the costo-coracoid membrane are now in view. The upper edge of the muscle is separated from the membrane, and at the lower edge of the muscle the muscular branch from the long thoracic artery is ligatured. The tendon of the muscle is now defined and divided close to its insertion into the anterior border of the coracoid process of the scapula. Further retraction of the ends of the severed muscles opens the axilla to such an extent that dissection can be proceeded with (Fig. 4). This dissection is best accomplished by means of a pledget of gauze. Beginning immediately beneath the clavicle on the outer surface of the first rib this type of gauze dissection removes the fat and cellular tissue which surround the axillary vein and is continued peripherally until the whole extent of the venous trunk is exposed. The various junctional vessels—superior, alar, and long thoracic—are divided between ligatures close to the parent trunk, the subscapular vessels lying at the periphery

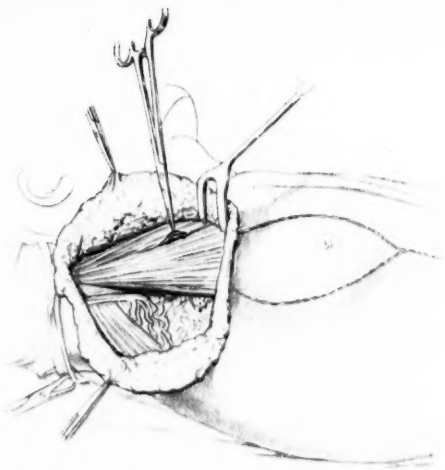


Fig. 2. *The first stage of the axillary dissection.* The separation between the sternal and the clavicular fibers of the pectoralis major muscle is defined, and in the space the thoraco-acromial vessels are isolated and ligatured.

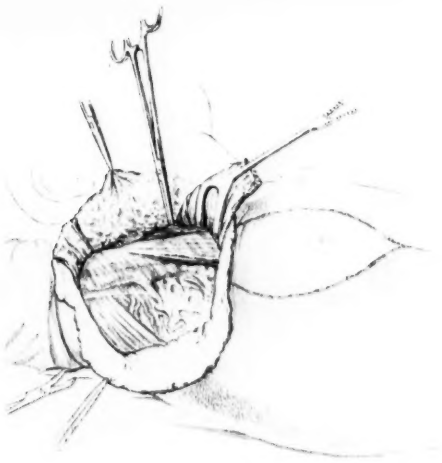


Fig. 3. The fibers of the pectoralis major muscle have been divided, and the central portion is retracted. The pectoralis minor muscle is in view. The thoraco-acromial vessel is seen piercing the costo-coracoid membrane at the upper edge of the muscle.

the dissection being retained (Fig. 5). The result of this procedure will be to separate a mass of glandular, fatty, and cellular tissue, which is dissected off the posterior wall of the axilla and carried inward toward the lateral chest wall. While this is being achieved certain anatomical structures are encountered—the intercostobrachial nerve, the lateral branch of the second intercostal nerve which is divided where it leaves the lateral chest wall and at the point of entrance into the arm and the three subscapular nerves, the short subscapular, the thoraco-dorsal, and the lower subscapular nerves, which are isolated and preserved. Toward the posterior part of the medial wall of the axilla the long thoracic nerve is exposed and cleared (Fig. 6). Where the inferior angle of the scapula comes into contact with the lateral chest wall a venous anastomosis between the subscapular and lateral thoracic vein is encountered, and if injured may give rise to troublesome oozing. These details may be said to conclude the preliminary dissection of the axilla, and the parts are covered with a sterile towel soaked in warm saline.

Exposure of the breast. The superficial aspects of the breast with its surrounding tissues are now exposed, and to do so the long oblique incision is deepened and its edges dissected in such a way that as much subcutaneous fat as possible is left in contact with the mammary area in order to secure the exclusion of the subcutaneous lymphatic groups. The limits of the subcutaneous dissection extend from the clavicle above to the costal margin and upper abdominal segment below, and from the breast of the opposite side to the level of the posterior axillary fold. By this means the anterior surface of the breast and its related structures are fully exposed to view.

The aim is now to remove in one continuous mass the glandular tissues of the axilla, the breast, the greater and lesser pectoral muscles, and the sheet of deep fascia which extends from the edge of the pectoral muscle over the lateral wall of the chest. The fascial dissection is of supreme importance, because it is in this structure that many of the deeper lymphatic vessels are distributed. To ensure its removal it is incised along a line which, beginning over the upper end of the sheath of the rectus abdominis muscle, extends obliquely upward and backward toward the inferior angle of the scapula, over the upper fibers of the external oblique muscle; it then passes upward dividing the fascia overlying the serratus anterior muscle on a vertical plane corresponding to the level of the posterior wall of the axilla, and ends at the level of the second rib (Fig. 7). The dissected axillary contents, together with the divided central ends of the pectoral muscle, being held toward the middle line, the operator separates the fascia from the underlying

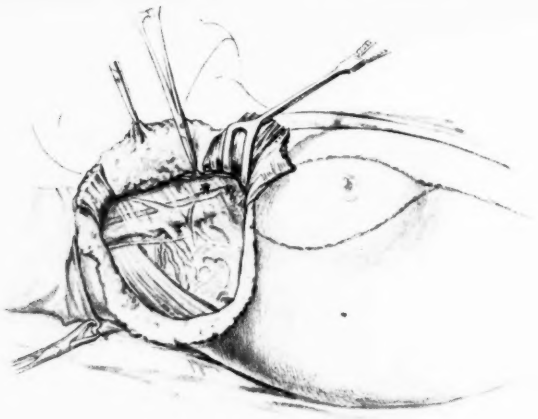


Fig. 4. Both pectoral muscles have been divided and the central ends retracted. The axillary area is now fully exposed to view.

muscles, and, continuing the subfascial dissection inward, the space beneath the pectoralis minor muscle is entered. At this stage the lateral branches of the intercostal arteries perforating the chest wall on a plane corresponding to the anterior wall of the axilla are divided and ligatured. The dissection is thereafter continued beneath the pectoralis major muscle, and as the lateral border of the sternum is reached the anterior perforating branches of the intercostal vessels are isolated, secured, and divided (Fig. 8). The separation is now virtually complete, the attachment of the pectoralis major from the front of the lower half of the sternum is divided, the fascial attachments to the upper portion of the rectus abdominis muscle are severed, and there is then removed in a continuous mass a group of tissues comprising the lymphatic and fatty tissue of the axilla, the breast with the greater and lesser pectoral muscles, and the fascial plane of the upper abdominal, lower thoracic, and lateral thoracic regions (Fig. 9). It will be observed that the removal of tissues has been achieved by working in the submuscular planes from the lateral to the medial side. By this means there is a reasonable continuity of dissection, the fascial removal is facilitated, while the blood supply is easily and effectively controlled. The exposed parts are now covered with warm towels soaked in saline, and the final dissection of the axilla is proceeded with.

Final dissection of the axilla. The removal of the breast and the pectoral muscles having afforded free access to all parts of the axilla, a careful survey of the area is made, and all fatty or fascial tissue which might harbor malignant cells is most scrupulously removed; the spaces around the axillary vessels and the cords of the brachial plexus are cleared; particular attention is paid to the apex of the axilla, and to the space behind the subclavius muscle. A line of fatty tissue following the course of the posterior thoracic nerve demands attention. The fascia which covers the muscles forming the floor of the axilla is dissected off the underlying structures, and the various subscapular nerves are isolated and cleared. The subscapular vessels, and particularly the circumflex scapular branch, around which lymphatic tissue may be deposited, are dissected, and throughout the procedure the aim of the operator is to secure the removal of any fatty, lymphatic, or areolar tissue in which malignant cells might be harbored.

Closure of the wound. A final survey of the operation field is now made, and, after complete hæmostasis is secured, the wound edges are approximated by interrupted sutures of silkworm gut and Michel's clips. Any difficulty in apposition may be overcome by undercutting the skin, or, if tension should appear to be unduly great, by the method of cross-scoring first suggested by Charles Mayo. If there be any real difficulty from the point of view of tension, it is better to be satisfied with incomplete closure than to risk the complication of sloughing. The open wound area may be grafted at the time of operation, using Thiersch grafts cut from the thigh or abdominal area and held in place by Stent supports, or it may be allowed to granulate and be grafted

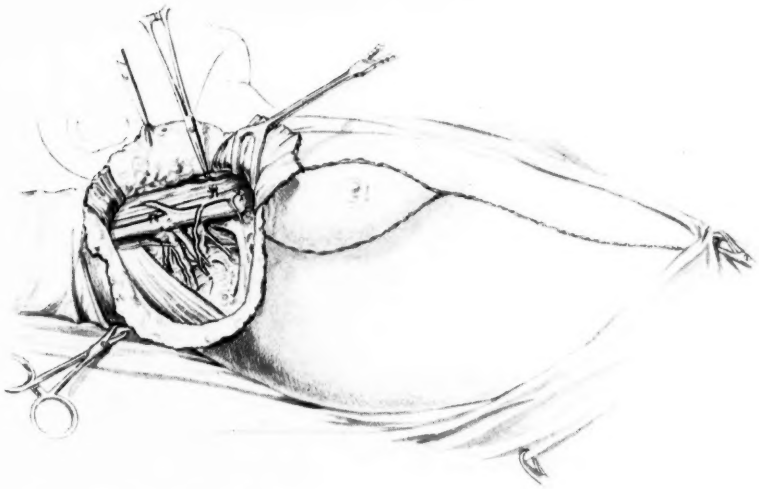


Fig. 5. The dissection of the axilla has been carried a stage further. The main vessels are defined and cleared by gauze dissection, while various junctional vessels are ligatured.

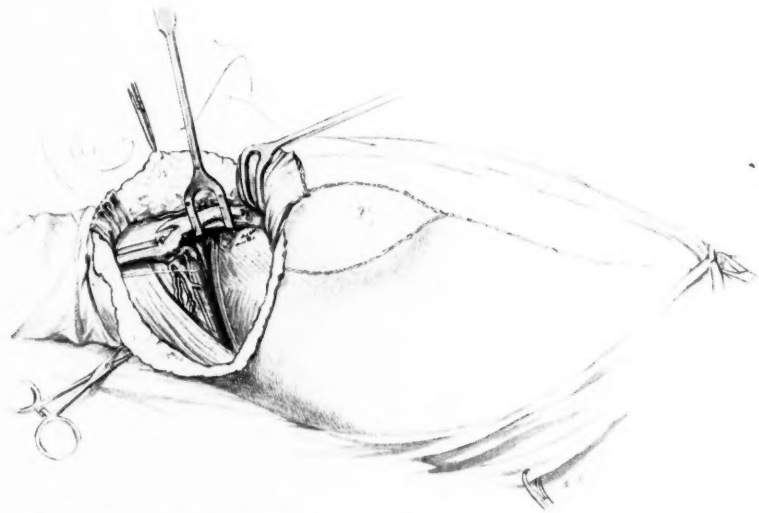


Fig. 6. The preliminary dissection of the axilla has been completed. The various junctional vessels have been ligatured with the exception of the subscapular group, the subscapular nerves are in view, and the long thoracic can be seen on the lateral chest wall.

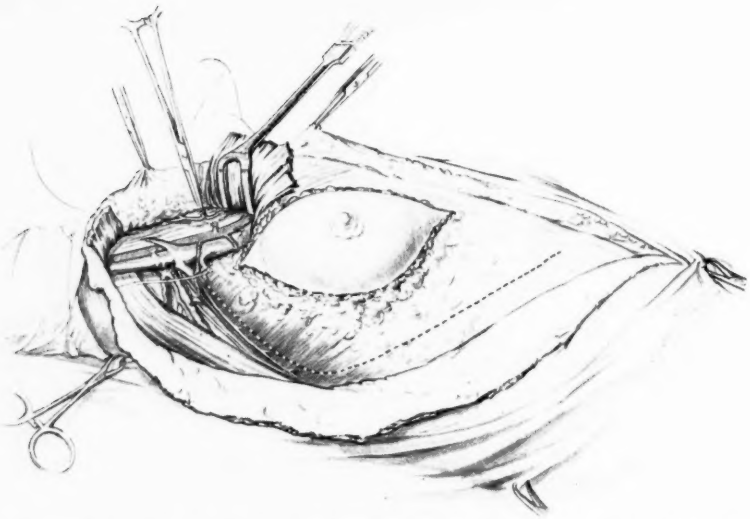


Fig. 7. The exposure of the breast has been secured by dissection of the skin edges, and the limit of division of the fascia has been outlined.

Fig. 8. The subfascial and submuscular dissection is continued. The lateral thoracic vessels have been ligatured, and the anterior perforating branches are being secured.

Fig. 9. *The final stage of the submuscular dissection.* The various vessels have been secured, and the muscles are being severed from their sternal attachments.

at a later date. Wound drainage is secured by means of a glass or rubber tube inserted through a stab wound at the dependent part of the dissected area.

DRESSING AND AFTER CARE

A large dressing of dry sterile gauze covered with a liberal supply of sterilized cotton wool is applied, and care is taken to ensure adequate covering of the more posterior portion of the wound area. A sterile domette bandage holds the dressings in place, and it is so applied that the arm is held abducted at a right angle. When the patient returns to bed the arm is supported on a pillow in its abducted position, and encouragement is given to use the hand and arm. The dressing is changed 48 hours after the operation, and at this time the drainage tube is removed. It is usual to remove the clips on the fifth day, and the stitches on the eighth day. In an uncomplicated case the patient is able to be out of bed by the tenth day.

THE Z PLASTIC OR WEB SPLITTING OPERATION FOR RELIEF OF SCAR CONTRACTURES OF THE EXTREMITIES[1]

HUGH T. JONES, M.D., F.A.C.S., Los Angeles, California

THE Z plastic operation is probably an ancient procedure but it is of use in the relief of certain of the residual contractures that have developed from the injuries and burns of modern industry and high speed transportation. Davis has been interested in tracing the history of the use of the Z plastic to 1856 when it was used by Devonvilliers. In more recent years particular attention to the procedure has been paid by Davis, Steindler, Kiskadden, and the author. It is a trick that the surgeon must ever have up his sleeve and, if remembered when needed, it will often solve a problem in an unexpected way. On the other hand it has very definite limitations and must not be used when other forms of plastic surgery offer more. I first saw the procedure most effectively used by Dr. M. S. Henderson in a burn contracture of the feet and legs of a child. Here the problem was solved in one short operation while, if any other plastic procedure had been used it would doubtless have consumed much time and have necessitated a series of operations (Fig. 3).

It is important to consider the indications as well as the contra-indications for the use of the Z plastic operation. It is to be used particularly in the contractures which present a rather extensive web of relatively soft and vascular skin, preferably with subcutaneous tissue. The web must be vascular enough to allow the shifting of flaps without tissue necrosis and elastic enough to accommodate itself to a change in shape that may be required to correct joint contracture. If the scarring is too intense and the web relatively avascular, leather-like, and hard, a postoperative slough may result. On the other hand, even though some of these scars be rather hard and avascular, if the flaps are sewed together without undue tension, a slough will not result. One must be careful not to choose the Z plastic operation when a full thickness skin transplant following wide excision of the scar will serve better. Though the Z operation may be found effective at times on the palmar surfaces of the fingers, one is apt to be disappointed by postoperative contractures that reproduce the flexion contracture that the operation sought to relieve. However, if it is likely that a certain degree of contracture may be relieved by the Z operation, this procedure may be used as the first step and other means be employed later for further correction, or the Z operation may be supplemented at the time by full thickness skin grafting.

There are other advantages to consider in the choice of the procedure: first, much less time is required for the Z operation than for a full thickness skin transplant or a pedicle graft; second, the Z operation is much more simple than a pedicle graft of any type and causes much less discomfort for the patient and less effort for the surgeon.

The technical description of the operation is best considered as a series of steps:

1. The web is split into halves (Figs. 1 and 2).

[1]Read before the General Surgery Section of the California Medical Association at the sixty-second annual session, Del Monte, April 24 to 27, 1933. Data and illustrations for the first three cases are from the Mayo Clinic.

Fig. 1, A.

Fig. 1, B.

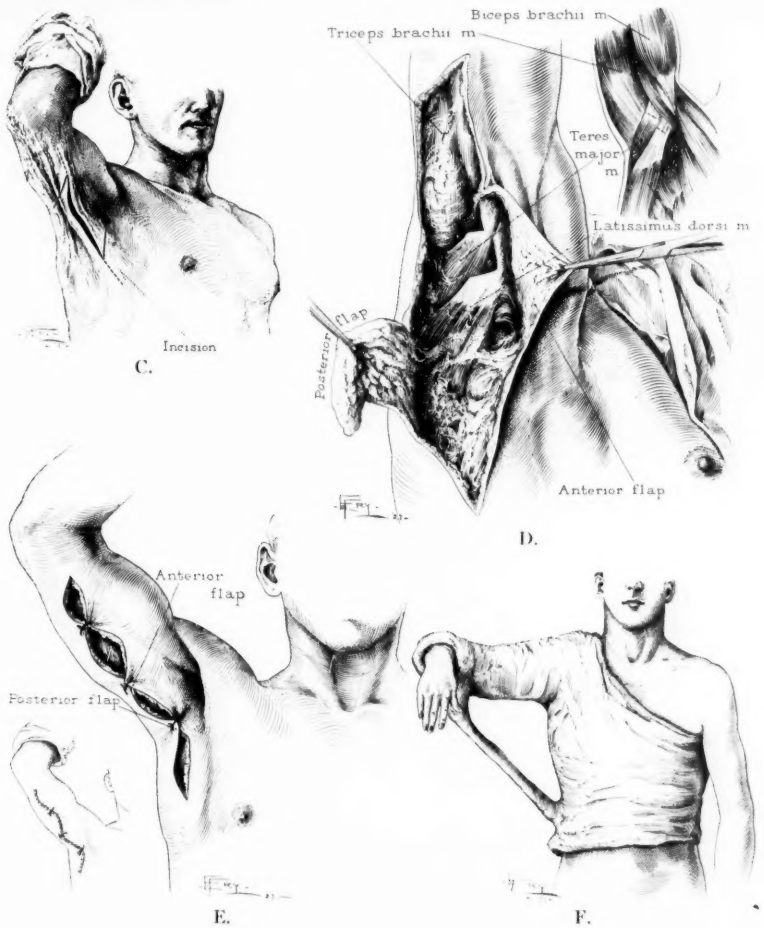
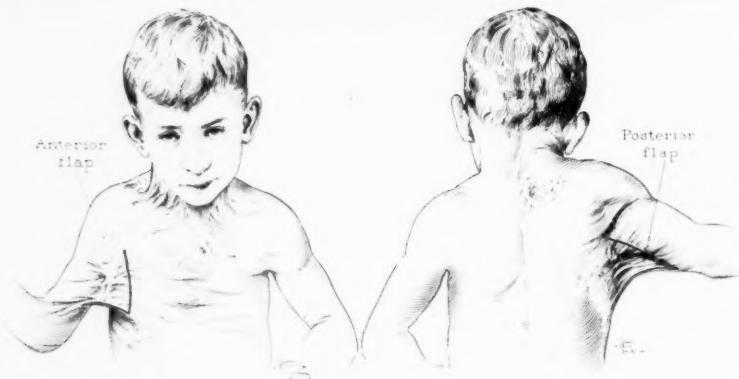
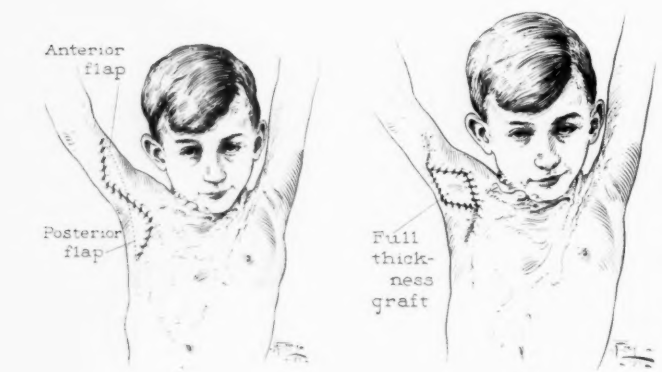


Fig. 1. Burn contracture of posterior axillary fold of 18 years' duration, relieved by Z plastic operation. In A, the muscular young man was abducting to the limit of the contracture. In B, the active range of abduction 39 days after operation is shown. In C, the incision for the Z plastic is shown. The web was cut into an anterior and a posterior flap. The anterior flap was cut away from the side, the posterior flap was cut away from the arm. The arm was then abducted but free abduction was found limited by contractures of the teres major and latissimus dorsi muscles. In D is shown the manner of lengthening of the teres major and latissimus dorsi muscles—the band-like tendons were cut about half way across from above downward. To gain free abduction, it was also necessary to excise considerable scar tissue in the axilla with due care not to injure vessels and nerves. It is to be noted that the tissue of the web was elastic enough to change shape as required by the new position of the arm and vascular enough to maintain nutrition. In E, it may be seen that the flaps had been trimmed, the anterior flap having been used to cover the defect on the arm and the posterior flap to cover the defect on the side. The scar tissue was excised two-thirds of the way down the arm and hence the long incision is seen in the illustration in addition to the Z plastic proper. In the suturing the main traction points were held by figure-of-eight silkworm gut sutures. Following operation a large dressing of fluffed gauze was applied. In F is indicated the plaster-of-paris cast that was applied to maintain moderate pressure on the field of operation, to afford rest, and to maintain abduction at the shoulder. This type of operation required much less time than a tube pedicle or any other type of repair at hand.

A. E. G.

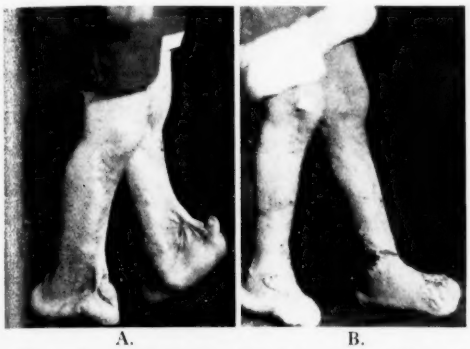


B. C.



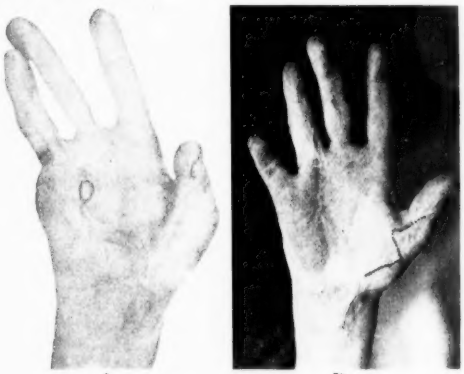
D. F.

Fig. 2. Burn contracture of entire axilla of 3 years' duration, in a boy of 6 years. A shows the pre-operative appearance of the web stretching from arm to chest. The web was fairly extensive and I judged it to be pliable and vascular enough to weather the Z plastic operation. B portrays the portion of the Z plastic incision seen from the front. The web was split along its inferior border into an anterior and a posterior half. The triangular anterior half of the web was cut away from the chest. C shows how the posterior half of the web was cut away from the arm leaving this half of the web attached to the chest wall; D, how anterior flap was wrapped around arm, and posterior flap around chest after arm had been abducted. Correction was maintained by a plaster cast. Sloughing appeared in axilla. E shows axillary slough 22 days after operation. On twenty-fourth day slough was excised and defect allowed to granulate as further correction of shoulder deformity was gained. Moist dressings of hychlorite (diluted 1:7) applied until 4 days later when a free, full thickness skin transplant was sewed into place. F diagrams full thickness transplant. G, 46 days after Z plastic operation indicating range of abduction gained as well as skin transplant that supplemented Z plastic.



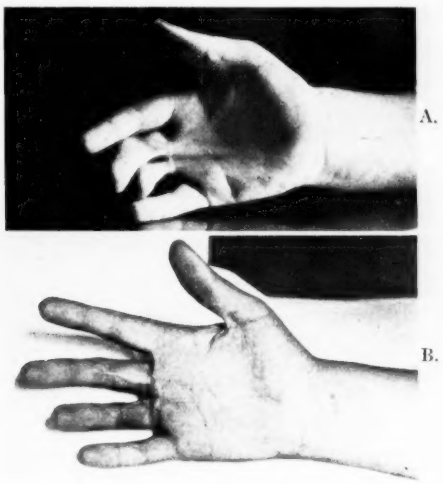
A. B.

Fig. 3. Burn contractures of the feet and legs with a web of tissue extending from the dorsum of each foot to each shin. The Z plastic operation was done by Dr. M. S. Henderson, and I, as assistant, was impressed by the marked improvement gained by a simple procedure. It seemed that a prepared puzzle had been solved. A shows the preoperative appearance and B the situation about 3 weeks after operation. The operation was carried out in the same way as described in Figures 1 and 2. The web was split into two halves, one triangular half of the web was cut away from the foot while the other half of the web was cut away from the leg. Then the one flap was wrapped about the leg and the other flap about the foot after correcting the ankle deformity.



A. B.

Fig. 4. A boy of 7 years had been burned at 17 months of age and a severe, hard contracture had resulted. A shows the condition of affairs. Particular attention is directed to the web of scarred skin connecting the thumb to the volar surface of the wrist and causing deformity. The little finger was completely covered by scar and held in the palm, the little finger nail alone being free. B, the postoperative appearance, is shown particularly to illustrate the relief of the thumb contracture by the Z plastic method. The web stretching from the thumb to the wrist was split along its margin into two halves and the contracture relieved by flap shifting as in the previous cases. This was a welcome procedure at the time because considerable time had been consumed in freeing the little finger and by the full thickness skin grafting for the palmar surface of the fifth finger and the ulnar side of the palm.

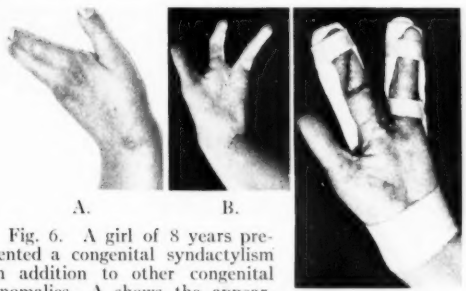


A.

B.

Fig. 5. Burn contracture of fingers of right hand relieved by Z plastic operation supplemented by full thickness skin grafting. A shows a considerable web of tissue connecting the middle finger to the palm. A Z plastic was done and it was learned that when the finger was fully corrected, the triangular flaps of skin were not extensive enough to cover the defect. Additional skin from the abdomen was then used as a full thickness graft to supplement the Z operation on the middle finger. The contracture of the fourth finger was treated by scar excision and a full thickness graft because the web was not extensive enough for the Z plastic operation.

2. One-half of the web is cut away from one limb of the contracture and the other half of the web is cut away from the other limb of the contracture (Figs. 1 and 2). In this way each half of the web becomes a flap to be shifted. One must estimate the degree of correction of the joint con-



A. B. C.

Fig. 6. A girl of 8 years presented a congenital syndactylism in addition to other congenital anomalies. A shows the appearance of the hand before separation of the fingers. In B, following separation of the fingers, a contracture is apparent limiting extension of the intervening finger. C shows the appearance about 2 weeks following the Z plastic operation which was carried out according to the same plan as shown in the preceding cases.

tracture to be gained and plan the shape of the flaps to fill the defects. Davis points out that the Z may be reversed, if more vascular flaps may be so obtained.

3. The deep contractures must be freed after the incisions are made. Excessive scar tissue must be removed, care being used not to injure important blood vessels or any nerves. It may be necessary to lengthen certain tendons as in Figure 1, D. Of course, one should not lengthen flexor tendons of the fingers in the field of this operation.

4. Hæmorrhage must be carefully arrested by warm, moist salt packs, very hot packs that may devitalize the avascular skin flaps being avoided. Vessels that require ligation are best tied by fine catgut, or, better, by pieces of split silk that make very small knots and do not irritate as much as large catgut knots.

5. The skin flaps should be protected throughout the operation from chilling and from drying by warm salt sponges. This is easier said than done actually, and the surgical nurses should be instructed to help in caring for this part of the work.

6. The flaps should next be trimmed to fit more perfectly the defects that they are to cover. Any cyanotic, purple areas indicating regions of defective circulation should be cut away. Davis directs that the points should be made blunt to avoid sloughing.

7. The flaps are sewed into place with figure-of-eight silkworm gut sutures where most stress is to come, the suturing being finished preferably with interrupted horse-hair or dermal sutures. Any running suture is not to be used because of the inhibiting effect on the circulation at the edges of the flaps caused by the lock stitch, for instance. There are exceptions to this rule, however, when the time element enters and one must use a lock suture to save time.

8. The field of operation is covered with a quantity of fluffed gauze to help afford even, moderate pressure.

9. A plaster-of-paris cast is applied for three reasons: to maintain correction of the deformity, to exert moderate pressure on the flaps and field of operation, and to afford rest to the field of operation. It is a matter of note that wounds heal well under casts. Casts are superior in this type of work to braces and splints because they cannot easily be removed by the patient or other interested persons; they do not shift; and the rest and moderate pressure that is afforded the skin flaps is probably more needed than frequent inspections.

In the postoperative care, the wound should ordinarily not be inspected for 2 weeks and at this time the stitches may usually be removed. The cast may be cut and reapplied as a splint, if it is thought necessary, while physiotherapy is being given.

Physiotherapy should consist of infra-red rays, great care being used not to burn the flaps that lack proper sensation and circulation. Massage and exercises are to be given as soon after removal of the cast as the condition of the wound will permit.

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OPERATIVE CORRECTION OF THE METATARSUS VARUS PRIMUS IN HALLUX VALGUS

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THE enormous wealth and great diversity of the operative procedures devised for the correction of hallux valgus deformity is eloquent proof that this problem is far from being adequately solved. However, it is not within the scope of this preliminary communication to go into any review of the very abundant literature on this subject.

The operation for correction of hallux valgus, as given below, is the result of the writer's personal study of this condition. There is no priority or originality claimed by the writer, except for the details of the operation, as he is fully aware, after a review of the literature, that there were a few surgeons in this country, as well as abroad, who had approached this problem in more or less a similar way to the one here presented.

The purpose of this paper is to stress the mechanical importance of the metatarsus varus primus, as one of the most frequent and most prominent factors of the hallux valgus deformity.

The cases of hallux valgus may be classified under three groups.

1. Cases with congenital predisposition toward hallux valgus formation, due to metatarsus varus primus. (The deformity may appear in early youth (Fig. 1) and is often hereditary.)

2. Arthritic hallux valgus, due to inflammatory periarticular contractures.

3. Paralytic hallux valgus, caused by loss of muscular balance.

It is unnecessary to say that this classification is more or less artificial, and there are possibilities of combinations of any of the features of these three classes in the same case.

The first group is the largest one, and the one mainly considered in the presentation.

It is admitted that in the process of phylogenetic development, the *homo sapiens* went through an arboreal stage of life. During this period, the foot had to adapt itself to a grasping motion when climbing trees, and therefore resembled the hand—because of greater mobility of the joints, and the presence of opposition of the big toe, similar to that of the thumb.

Sameness between the hand and the foot is also observed in primates, who use their feet for grasping. In man, the foot serves mainly as a supporting limb, and therefore the human foot had to lose its mobility—the hallux becoming strengthened, and the other toes diminishing. The hallux of primates resembles more the thumb, because of its freer range of motion, and the large angle formed by the first and second metatarsals (Fig. 2). To a lesser degree, it may be noted in the human embryo, and infants.

Among many changes that took place in the plantigrade human foot, due to special demands made upon it, in the course of human evolution, there is a marked differentiation between the hallux and the thumb. The first metatarsal in the well developed human foot is nearly parallel to the second (Figs. 3, A and B). Classical paintings and sculpture depict the long and rather narrow foot as an example of beauty and perfection, long before orthopedic surgeons thought of it. Thus it may be assumed that the adult foot, presenting marked fan-shaped spreading of the metatarsals (*spreiz-fuss* of German authors), with a large angle between the first and second metatarsals (metatarsus varus primus), and therefore with a large space between the first and second metatarsal heads, must be considered as an atavistic foot, which never became fully developed. This is a type of foot which most commonly forms a hallux valgus (Fig. 1) and thus the often observed hereditary predisposition toward this deformity can be readily understood.

An excellent illustration of this atavistic type of foot, with metatarsus varus primus, presenting congenital potential predisposition toward hallux valgus formation was observed by the author in a case of middle aged brother and sister. The sister developed "bunions" in young age, as a result of wearing the usual distorting ladies' shoes, while her brother's feet remained normal, because of wide, straightlast shoes, which checked this potential tendency (Fig. 4, A and B).

The first precursors of incipient "bunion" as a rule are observed in girls with atavistic foot at the age of about thirteen and fourteen when they first start to wear a narrow pointed shoe with a high heel. The weight bearing is thrown more on the forefoot, and the force of gravity itself tends to produce further spreading of metatarsals and to increase the metatarsus varus primus.

The thumb-like hallux has no room in the narrow, and often short, shoe. It is gradually de-

[1]From the service of Dr. Leo Mayer. [2]From the service of Dr. Percy Willard Roberts.

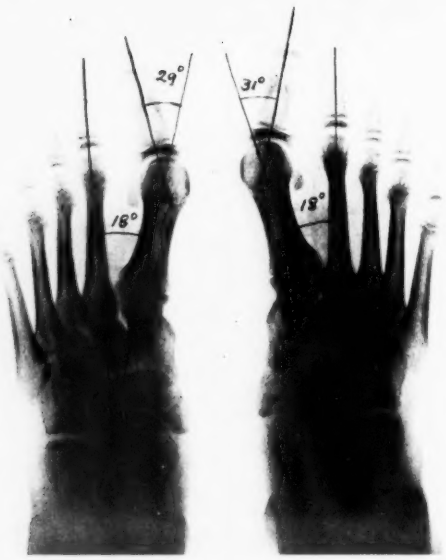


Fig. 1. Roentgenogram of feet of a girl 9 years old. Typical atavistic foot with metatarsus varus primus and hallux valgus deformity in spite of the fact that the child had never worn narrow shoes.

viated toward the second toe and adopts a valgus position, which consequently becomes fixed. The base of the proximal phalanx subluxates laterally upon the first metatarsal head and pushes the latter medially. The already congenitally relaxed transverse ligament between the first and second metatarsal heads becomes even more stretched, thus contributing to the increase of the original metatarsus varus primus.

The first metatarsal head protrudes medially and sometimes a bony proliferation forms over its medial part as a result of chronic trauma against the shoe. As pointed out by Hiss, the abductor hallucis is the only muscle preventing hallux valgus formation. This muscle is much weaker than the abductor hallucis, the latter's action favoring the valgus position of the big toe. Besides that the short and long flexors and extensors of the big toe also contribute to the hallux valgus deformity as they become displaced laterally to the first metatarsophalangeal joint and their pull increases the angulation between the first metatarsal and the basal phalanx. The lateral displacement of the sesamoids over which run the tendons of the two heads of the flexor hallucis brevis is a commonly observed condition (Fig. 5, A and others).

In cases of considerable varus position of the first metatarsal, there is a large space between the first and second toes. This space may accommodate the big toe in hallux valgus position (sometimes over 45 degrees) without the big toe overlapping the second or being overlapped by the latter. On the other hand, this overlapping of the big toe by the second, or the reverse, must necessarily take place, even in mild cases of hallux valgus deformity, without presence of the metatarsus varus primus, because the first and second toes lie very close to each other.

I believe that the congenital metatarsus varus primus in the majority of cases is the primary deformity leading to secondary formation of the hallux valgus. In other words, the medially opened angulation between the first cuneiform and the first metatarsal, causes the compensatory angulation open laterally between the big toe and the first metatarsal. This occurs in somewhat similar manner as the dorsal kyphosis of the spine is compensated by an increased lumbar lordosis. It can readily be seen that any attempt at correction of hallux valgus by only adducting medially the big toe and bringing it in alinement with the first metatarsal, will be futile, in a foot presenting metatarsus varus primus. In this case, after successful correction, the big toe will be widely separated from the second toe, and will protrude medially. This kind of foot with a *thumb-like hallux* would fit more easily into a glove than a shoe, unless the big toe were again brought back to hallux valgus position (Fig. 6).

Consequently any operative procedure designed only to straighten the secondary angulation between the first metatarsal and the big toe, or only correcting the hallux valgus itself, is prone to have a recurrence of the deformity, unless the varus position of the first metatarsal will also be corrected, as the latter is the primary underlying cause in the majority of cases of hallux valgus. A few operative procedures in the past aimed to correct the medial deviation of the first metatarsal, by means of varied osteotomies at different parts of this bone, or through the first cuneiform.

The only way to make a straight line of two lines forming an angle less than 180 degrees, is by moving the free end of one of the lines around the point of their cross section as a center, until the two lines will form an angle of 180 degrees. In order to correct any bony angulation, the osteotomy should be made at the apex of the angulation. The knock knee deformity is treated by an osteotomy as near the knee joint as possible, as the apex of the angulation between the tibia and the femur is usually located near this

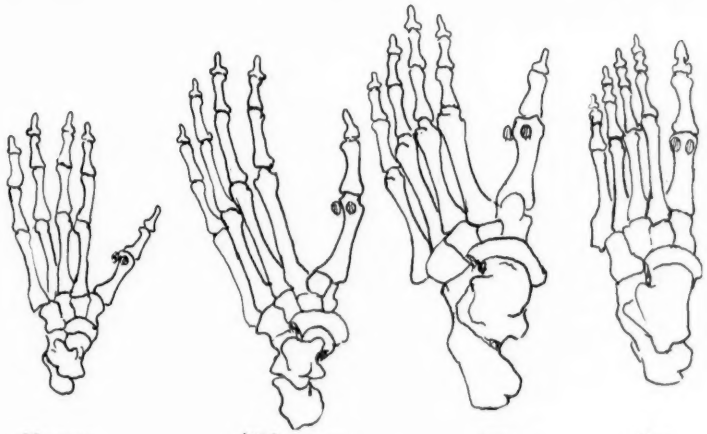


Fig. 2. Note the thumb-like big toe of primates with marked varus position of the first metatarsal. (Adapted with modification from Hiss, J. M. Am. J. Surg., 1931, xi, 53).

joint. No one would try to correct a knock knee by osteotomizing at the middle of the tibia, or of the femur, for example. Therefore, the only mechanically sound osteotomy for correction of metatarsus varus primus should be located at the first cuneiformometatarsal joint, which is the apex of the angulation between the first metatarsal and the first cuneiform.

Without going into detailed description of the anatomy of the region of the first cuneiformometatarsal joint, a few important points should be mentioned. The articulating facets of the first metatarsal and the first cuneiform resemble a lima bean, the long axis of which lies in a dorsiplantar direction. The concavity of the bean is toward the second cuneiform—the convexity toward the medial border of the foot. The plane of this joint extends from dorsal, anterior, and lateral to plantar, posterior, and medial directions; in other words, the articular facet of the first cuneiform, after removal of the first metatarsal, will face medially and slightly plantarward. The more medial slanting of the facet of the first cuneiform, the more pronounced is the varus position of the first metatarsal.

The occasionally present intermetatarsal articular facet and the lateral dorsal part of the first metatarsal base impinge against the adjacent medial aspect of the base of the second metatarsal, and prevents lateral abduction of the first metatarsal, toward the second metatarsal. That is why this part of first metatarsal base should be chiseled off in correcting metatarsus varus primus.

The second cuneiform is shorter than the first. Therefore the line of the second cuneiformometatarsal joint on the dorsum of the foot lies about 1 centimeter proximally from the line of the first cuneiformometatarsal joint. The dorsalis pedis artery with its plantar branch passes closely between the bases of the first and second metatarsal bones and should be spared during the operation.

DESCRIPTION OF THE OPERATION

The operation is better performed without the use of a tourniquet, as the bleeding is negligible, and it is preferable to control it during the operation.

A longitudinal incision, about 5 centimeters long, is made on the dorsimedial aspect of the foot. The incision should correspond to the line of the joint between the first and second cuneiforms. The line of the first cuneiformometatarsal joint should cross the middle of the incision. The tendon of the extensor hallucis longus is retracted medially without opening its synovial sheet. Occasionally it is necessary to lengthen this tendon. The first cuneiformometatarsal joint and the adjacent parts of the bases of the first and second metatarsals are exposed subperiosteally, care being taken not to cut the dorsalis pedis artery and its branches.

The tuberosity of the first metatarsal, impinging against the second metatarsal base, is chiseled off, the plane of the chisel being held parallel with the long axis of the first metatarsal, and strictly in dorsiplantar direction (Fig. 7, A). The adja-

A.

B.

Fig. 3. A, Long narrow feet. The big and second toes lie close together. B, Roentgenogram of the same feet showing first and second metatarsals almost parallel to each other. This type of foot had no potential tendency to hallux valgus formation. Note that even in this type of foot there is a slight "physiological hallux valgus." Two sisters and father of this patient had also similar type of feet.

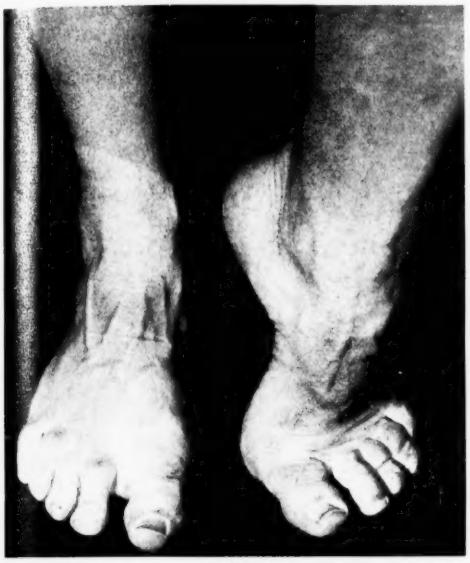
cent part of the second metatarsal base is also roughened with a curette.

After that, a small wedge with the base laterally, is removed from the articular surfaces of the first metatarsal and the first cuneiform, only over their lateral aspect (Fig. 7, B and C). The medial part of the first cuneiformometatarsal joint should be left intact except being denuded from its cartilaginous covering. The base of either wedge removed from the first metatarsal and the first cuneiform should not be wider than about 3 or 4 millimeters each (somewhat more bone should be removed from the cuneiform). The last two points—(1) not to osteotomize the medial part of the adjacent articular surfaces of the first metatarsal and the first cuneiform; and (2) not to remove too wide a wedge—are of extreme importance, especially the first one. The aim of the operation is to produce a bony fusion of the first metatarsocuneiform joint and adjacent bases of the first and second metatarsals in corrected position. Too large a resection of bone, creating a large gap, may be not favorable for bony fusion.

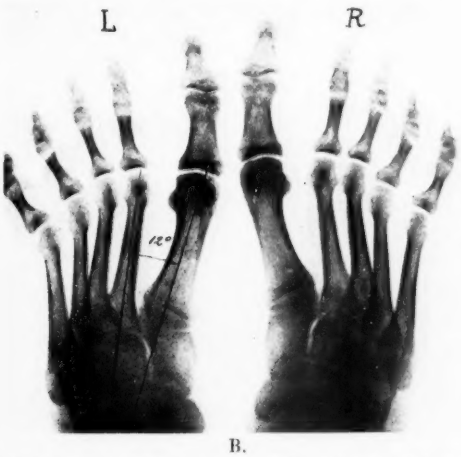
Transverse resection of the whole first cuneiformometatarsal joint (also over its medial part) as advocated by a few surgeons, will produce a shortening of the first metatarsal, causing considerable disturbance of the statics and dynamics of the foot. The first metatarsal bone serves as a medial buttress of the foot, preventing its pronation. The head of the first metatarsal with the underlying two sesamoid bones, is the medial anterior weight-bearing point of the foot. Any shortening of the first metatarsal, will, therefore, result in an increase of pronation of the foot. Beside that, the second metatarsal head will be much longer, compared with the first, and will become the weight-bearing point, instead of the first metatarsal head, resulting in pain and formation of tender callosity, beneath the anterior arch.

The big toe plays an important part in the process of locomotion. There is a phase in walking, and especially in running, when the whole weight of the body is borne by the first metatarsal head, with the big toe in extreme dorsiflexion (Fig. 4, A, left foot). Shortening of the first metatarsal will weaken the action of the plantar and dorsal flexors of the big toe, because the distance between the origin and insertion of these muscles will become diminished. This will create some disturbance of gait.

Case 1 serves as a good illustration (Fig. 3). About a year following the operation, the patient developed pain and tender callosities beneath the metatarsal heads, especially the second, and markedly diminished power of motion of the big toe was also observed, as a result of the shortening of the first metatarsal. Thus any operation leading to the shortening of the first metatarsal should be emphatically condemned, because the sacrifice of functional disturbance of the foot is too great a price to pay for cosmetic correction of bunion.



A.



B.

Fig. 4. A, Square shaped atavistic feet with widely separated big and second toes. This type of foot has a potential tendency toward hallux valgus formation. The sister of this man, with same type of foot, developed hallux valgus. Left foot is shown during a phase of gait when the whole weight is borne mainly on the first metatarsal head with the big toe in extreme dorsiflexion. B, Roentgenogram of the same feet showing metatarsus varus primus of 12 degrees. Note wide space between big and second toes easily permitting lateral deviation of the big toe in hallux valgus position.

After the resection of the first cuneiformometatarsal joint described, the first metatarsal head can be abducted laterally, without much effort, bringing it closer to the second metatarsal head, and thereby easily correcting the metatarsus varus primus. The capsule and the ligaments of the first cuneiformometatarsal joint should be preserved as much as possible, especially over its plantar aspect.

Most cases of hallux valgus are also associated with a weak foot, presenting flattening of the longitudinal arch and pronation. This is, to some extent, due to the dorsiflexed attitude of the first metatarsal in the cuneiformometatarsal joint. It is advisable, therefore, when resecting the first cuneiformometatarsal joint, to remove slightly more bone over the plantar aspect of this joint, creating, in this way, another wedge with a plantar base. The plantar flexion attitude of the first metatarsal is thereby produced and will increase the longitudinal arch and diminish pronation.

A second incision, also about 5 centimeters long, is made over the dorsimedial aspect of the first metatarsophalangeal joint. The medial part of the joint capsule is bluntly exposed. A tongue-shaped flap, with its base attached to the proximal phalanx, is made over the medial part of the joint capsule. The bony projection over the medial, and often over the dorsal, part of the first metatarsal head is chiseled off, care being taken to remove all the bony projections interfering with motion of the big toe, especially in its dorsiflexion. The adductor tendon and the lateral part of the joint capsule are tenotomized, if necessary, so that the big toe may now be freely brought in an overcorrected position, without using any force. Usually the big toe in hallux valgus has a tendency toward a slight internal rotation, around its long axis, so that the nail is facing medially (Figs. 5, A, 10, A). That tendency may be a remainder of opposition of the big toe, present in primates, and should be taken into consideration during the suturing of the capsule. A heavy chromic mattress suture is inserted first over the plantar distal part of the capsule in front and medially to the tibial sesamoid. The needle is then brought through the dorsal proximal part of the joint capsule and the deep aponeurosis. This suture crosses obliquely the medial part of the first metatarsophalangeal from its plantar and distal toward the dorsal and proximal parts.

After tying of this suture four important points are gained: (1) the big toe is fixed in adduction medially; (2) the internal rotation of the big toe is corrected; (3) the lateral displacement of the sesamoids together with the plantar flexors of the

A. B.

Fig. 5. A, Case of "bunion" with marked medial protrusion of the first metatarsal head and lateral subluxation of the big toe. Note the lateral displacement of the sesamoids and inward rotation of the big toes, the nail facing medially. The foot is very wide across metatarsal he s. B, Same feet after the operation. Note also the correct on of internal rotation of the big toe and practically nor al position of the sesamoids.

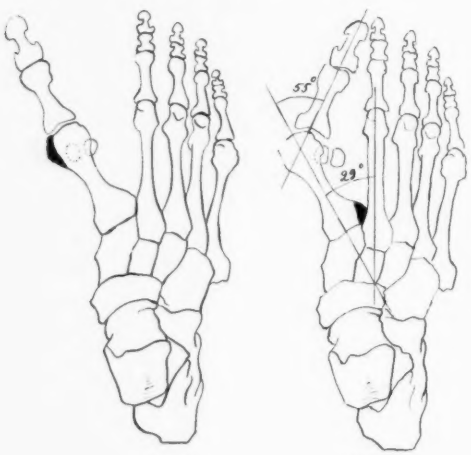


Fig. 6. Fig. 7, A

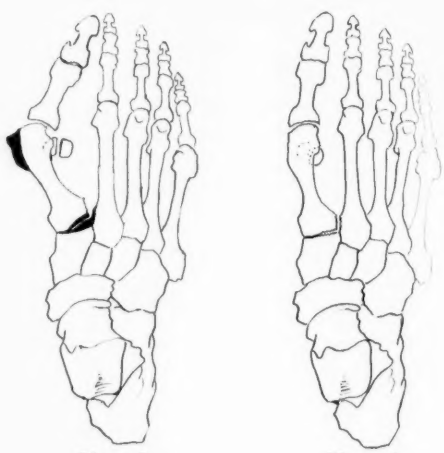


Fig. 7, B Fig. 7, C

Fig. 6. Imaginary postoperative appearance of the foot in case of successful straightening of the big toe without correcting the metatarsus varus primus. (All relations slightly exaggerated.) Note close resemblance with the foot of primates shown in Figure 2. Black area shows the bony prominence which is usually removed.

Fig. 7. Varus position of the first metatarsal is slightly exaggerated for the sake of demonstrability. (The angle between first and second metatarsals is made 29 degrees, while it is seldom over 20 degrees; hallux valgus of 55 degrees is rather common.) Black areas show the parts of bone which are removed. Note the lateral displacement of sesamoids. A, Lateral part of the base of the first meta sal impinging against the second, is removed. B, Resect n of the first cuneiformometatarsal joint over its lateral p t only. Note that slightly more bone is removed from e first cuneiform. The adjacent part of the second m tarsal base is roughened with a curette. Removal of e bony proliferation over the first metatarsal head d plastic of the capsule over the medial aspect of the t metatarsophalangeal joint. C, Metatarsus varus pri and hallux valgus are corrected. Note the sesamoids retur l to their normal location.

big toe is reduced and this reduction maintained; (4) the deep dorsal aponeurosis with the extensor hallucis longus tendon is pulled medially preventing lateral displacement of this tendon. The tongue-shaped flap of the capsule is now resutured, with the big toe held in adduction, and slight external rotation. The tendon of the abductor hallucis may also be reattached to the medial flap of the joint capsule, thus providing active force, correcting the hallux valgus deformity. The removal of the lateral prominence of the fifth metatarsal heads may also be indicated in some cases.

The deformity must be entirely corrected by the operative procedure alone, so that the big toe will maintain this correction, even if left unsupported. A tight flannel bandage is applied over the well padded forefoot keeping the metatarsals closely approximated. In about 2 or 3 weeks a plaster-of-paris casing is applied to the foot maintaining the correction of metatarsus varus primus. The big toe is not included in the casing and its active and passive motion is encouraged.

A few points in pre-operative preparation of the skin are worth mentioning, as insuring primary union of the wound. It is advisable to prepare the skin over the "bunion" by means of shaving off the callosity and applying salicylic acid ointment a few days or sometimes a few weeks before the operation. A very often present, but usually overlooked, trichophytosis of the foot should be cured before the operation is undertaken.

The writer also believes that the often used oval excision of the skin around the "bunion" should not be practiced, as it may cause tension when the skin is resutured and lead to separation and sloughing of the wound edges. No attempt to remove the bursa is made by me, as a rule, as both the callosity and the bursa readily disappear after the underlying cause—the undue pressure—is eliminated with the correction of the deformity.

It is also important to stress the postoperative care in these cases. A rigid metal plate should be worn by every patient for a few months following the operation, as the keystone of the longitudinal arch—the first cuneiformometatarsal joint—is weakened by this operation, and has to be protected until it will regain its strength. Full weight bearing should not be allowed before 6 or 7 weeks in order to insure solid fusion of the resected cuneiformometatarsal joint.

The somewhat prolonged period of postoperative disability and the resection of the joint supporting the longitudinal arch may be considered the weak points of this operative procedure. The

Fig. 8. Case 1. Right foot of girl 21 years old before and after the operation. (Operated upon April 8, 1931.) Excellent correction of the hallux valgus. Note the marked postoperative shortening of the first metatarsal. About one year after the operation this patient developed heavy callosity over the whole anterior arch, which became markedly convexed. There was tenderness over projecting plantarward second metatarsal head. When she stood the big toe was kept above the floor and there was marked loss of power on motion of the big toe. Functional result is therefore considered by the author as unsatisfactory because of shortening of the first metatarsal.

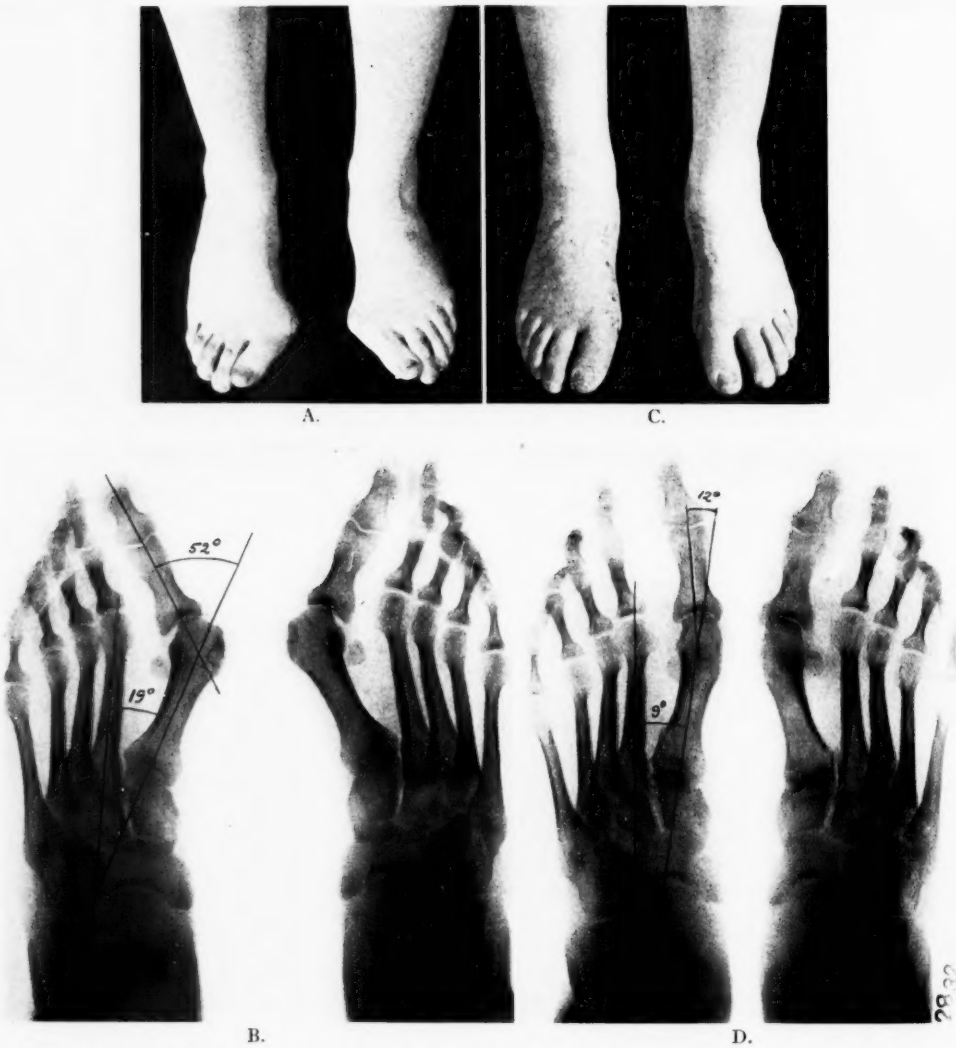
number of cases is too small as yet, and the time following the operation too short, to make any definite conclusions. (The first case was operated upon April 8, 1931.) However, the writer feels that both the functional and cosmetic results thus far obtained are more than encouraging, and therefore warrants giving this operation further trial in cases of hallux valgus with metatarsus varus primus (Fig. 9, A, B, C, D, 10, A, B).

Not every patient with "bunion" should be operated upon, operation being limited to cases of functional disturbance, or where cosmetics plays an important part. Each case requires individual study.

SUMMARY

1. In a great majority of cases of hallux valgus, there is metatarsus varus primus, which is the primary underlying cause of the deformity—hallux valgus occurring secondarily because of shoe pressure.

2. Hallux valgus, or "bunion," is not so much a lateral deviation of the big toe, as the medial

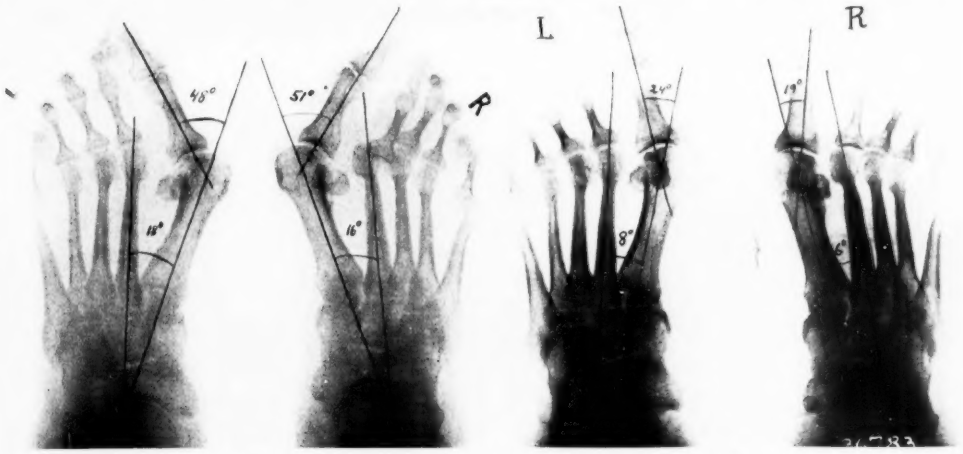


A. C. B. D.

Fig. 9. Case 2. A, Feet of a girl 21 years old. Note that in spite of very marked hallux valgus deformity, there is no overlapping of the big and second toes. B, Roentgenogram in the same case showing atavistic feet with metatarsus varus primus of 19 degrees and hallux valgus of 52 degrees. C, Appearance of the same feet 6 weeks after the operation performed on February 3, 1932. Excellent cosmetic and functional result. The circumference of the f across metatarsal heads became about 2 centimeters l than before the operation. D, Postoperative roentg ogram in the same case. The metatarsus varus primu reduced from 19 degrees to 9; the hallux valgus from degrees to 12.

protrusion of the first metatarsal head forming bony proliferation because of constant trauma.

3. There is a type of square foot, with a widely spread metatarsal head and metatarsus varus primus. This foot closely resembles that of p mates and is considered atavistic. In a well veloped human foot, the first and second me tarsals lie almost parallel; the latter type v seldom developing "bunion."



A. B.

Fig. 10. Case 3. A, Feet of woman 35 years old. Note also dorsal subluxation of the basal phalanx of the right second toe and the lateral projection of the fifth metatarsal heads. B, Postoperative roentgenogram in the same case.

4. This atavistic foot has a congenital potential tendency toward hallux valgus formation, and therefore hallux valgus is often hereditary, appearing in youth, mostly in women, because of their type of shoe.

5. No operative procedure is satisfactory, unless correction of the metatarsus varus primus is accomplished.

6. Operation for correction of metatarsus varus primus by resection of a small wedge, at the lateral part of the first cuneiformometatarsal joint, is described.

7. Any operation creating shortening of the first metatarsal, or the big toe, is emphatically condemned as unphysiological, and causing static and dynamic disturbance of the foot.

8. Conservatism and individualization in indication for operative correction of "bunion" is advocated.

Indebtedness is acknowledged to Dr. Leo Mayer, for kind permission to use this operation on his service.

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THE DIAGNOSIS OF TRICHOMONAS VAGINALIS VAGINITIS

Preliminary Report on a New Method

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IN recent years the gynecologist has been faced with the ever increasing problem of the diagnosis and treatment of Trichomonas vaginalis vaginitis. Undoubtedly, this is one of the most frequent causes of leucorrhœa and because of this fact it is of paramount importance to find a simple way of diagnosing and treating this infection.

The usual method of diagnosing Trichomonas vaginalis vaginitis is as follows: a drop of vaginal secretion is placed in a drop of normal saline solution on a plain or hanging drop slide; a cover slip is placed over the suspension and the specimen is examined at once under the high power lens of the microscope. Many pus cells, epithelial cells, and innumerable trichomonads are seen. The organism is in constant motion and when free of débris moves very rapidly; if dead, it cannot be differentiated from a pus cell.

Although this is a simple procedure, it takes several minutes of the doctor's valuable time, especially when more than one hanging drop of secretion taken from different parts of the vulva and vagina is examined. Often living organisms are not found because the patient has had recent douches or treatments or because lubricant on the examining finger inactivates the trichomonads. A single plain water douche may inactivate the organisms so that a diagnosis cannot be made. In these cases the discharge must be examined repeatedly, preferably after a menstrual period. The patient should not have taken douches or vaginal treatments. In several individuals it has taken months to find live trichomonads in a persistent, profuse vaginal discharge.

In 1932, we began a study of the Trichomonas vaginalis vaginitis and many slides were stained according to the Schaudinn's fixation iron hæmatoxylin method. This procedure is the usual one for staining flagellates, but requires much time and experience. It is almost impossible to complete the staining under 24 hours. Frequently the results are not very satisfactory. However, when a good smear is obtained, the details of the trichomonad are well brought out.

Careful study of these iron hæmatoxylin smears disclosed the fact that the protoplasm, nucleus, and vacuolization were very definite and unchanging. The flagella were not always easily seen, but could be found if carefully studied and frequently were quite prominent. The Trichomonas vaginalis may be pear-shaped, round, oval, or irregular with amœboid processes. It varies in size from 7 to 30 microns. It has an oval or spindle shaped nucleus, close to the anterior end, where four flagella arise. A fifth flagellum can occasionally be seen arising from a blepharoplastic granule. The undulating membrane is not always visible, but arises from the anterior end and extends about half the length of the body. An axostyle may be seen.

In smears from cases of untreated Trichomonas vaginalis vaginitis, a large diplococcus was always found covering the entire slide. Gram stained preparations showed this to be a gram positive organism. This gram positive diplococcus often but not invariably disappeared as the patient received treatment and the clinical symptoms improved. The trichomonads decreased rapidly in numbers as treatment progressed.

It has been noticed that trichomonas-like organisms were frequently found in the routine gram stained smears. These organisms showed the body structure of the trichomonad, but were so similar to pus cells that they might easily have been mistaken for them. The large gram positive diplococcus found in these smears was difficult to differentiate from the gram negative diplococcus of gonorrhœa. This difficulty is well illustrated by a case observed during this study.

The patient, a single, 18 year old girl, with a severe acute vaginitis was first seen in a clinic where a microscope was not available. Routine smears were taken and sent to three different laboratories. The reports were variable. One laboratory reported gram negative intracellular diplococci. The second laboratory found gram negative diplococci not definitely intracellular. The third report was negative for gram negative intracellular diplococci. A few days later a hanging drop examination was made and myriads of Trichomonades vaginalis were found. Because of the varied reports new smears were taken and some of the original gram stained smears were obtained from the laboratory that had reported them as suspicious. These smears were examined and showed typical Trichomonas vaginalis with definite flagella and many gram positive diplococci (Fig. 1). No gram negative diplococci were found. These smears have since been examined by several physicians and technicians who have agreed that the diplococci were gram positive and not gram negative.

The gram stained smears of this patient showed the flagellate so definitely that it was decided that

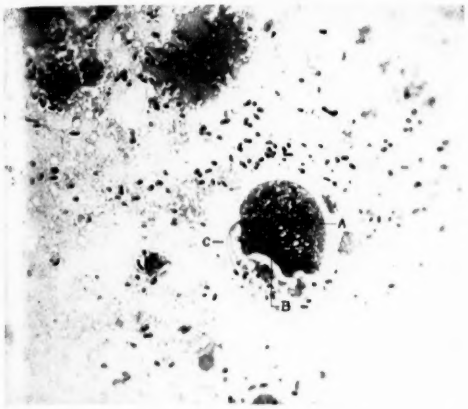

Fig. 1. *A*, Vacuolated protoplasm of Trichomonas vaginalis; *B*, nucleus and axostyle; *C*, flagella.

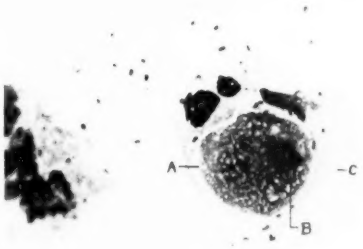

Fig. 2. *A*, Vacuolated protoplasm of Trichomonas vaginalis; *B*, nucleus; *C*, flagella.

if carefully examined, Trichomonas vaginalis could be found on a routine gram stained smear.

It was discovered during this study that although the gram stain showed the typical body structure of the Trichomonas, the flagella were not frequently visible. Many different stains were tried in an effort to bring out the flagella, and finally a dilute carbol fuchsin stain was found that invariably showed the trichomonas flagella and good body detail (Fig. 2). With this stain much of the débris of the smear is washed out, leaving epithelial cells, pus cells, beautifully stained trichomonads with flagella and the ever present diplococci.

The technique of making carbol fuchsin stains is simple and includes the following steps: (1) smears are made thin; (2) they are fixed in air, not flamed; (3) the slides are covered with carbol fuchsin (about 20 to 25 drops); (4) 20 drops of distilled water are added and allowed to stand for 3 minutes; (5) the slides are washed with distilled water and dried between filter or blotting papers; (6) examination made under an oil immersion lens.

At the present time two dry smears and a hanging drop are taken in every case. One dry smear is stained by the usual gram stain method and the other by carbol fuchsin. A diagnosis is made from these before the result of the hanging drop, done by another technician, is known. Of 90 smears examined,[1] 66 per cent were found positive and 34 per cent were found negative for Trichomonas vaginalis; of these 90 smears the hanging drop examinations were positive in 41 per cent and negative in 51 per cent. In 8 per cent of the cases no hanging drop examination was made. Positive findings in hanging drop examinations were shown in only 63 per cent of the cases with positive smears.

This preliminary report is offered with the hope that the Trichomonas vaginalis may be recognized in an ordinary dry smear stained with carbol fuchsin. It will save much time if a dry smear for diagnosing Trichomonas vaginalis vaginitis is taken at the time when the usual smear for gonorrhœa is made. Furthermore, the diagnosis of Trichomonas vaginalis vaginitis should be more accurate from a dry smear than from a hanging drop because of the possibility of the inactivation of the organism in the suspension.

Further reports will be published of this study as soon as completed. It is hoped that a study of vaginitis in children and the non-specific urethritis of men can be included in the next report, and as well the relationship and importance of the gram positive diplococcus that is found in association with the Trichomonas vaginalis.

[1] The majority of the smears studied were obtained in the gynecological clinic of the New York Infirmary for Women and Children. Photographs by M. E. Fellers of the New York Infirmary for Women and Children.

SUMMARY

1. Trichomonas vaginalis vaginitis can be diagnosed from a dry smear by a simple carbol fuchsin stain.

2. Trichomonas vaginalis can be recognized on a gram stained smear, but the diagnosis is not as definite as when the carbol fuchsin stain method is used.

INTERNAL FIXATION OF FRACTURES

A Simplified (New) Method

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THE attempt to hold fragments of a fractured bone in position by means of some foreign material dates back over a century from this time. The earlier efforts were made in compound fractures by simple suture with wire and then later in simple fractures by some device which merely penetrated the skin but which did not expose the bone. As surgery developed and the exposure of fractures through open operation became safe, the mechanical center of the surgeon's brain ran unrestrained and many devices, contraptions, and gadgets were suggested for what has become universally called "internal fixation" of fractures. It would doubtless be futile to attempt to discard this terminology but it is imperative to emphasize that, in all types and in all forms of "internal fixation," the actual fixation of the fracture is obtained through an efficient external splint. The surgical steps taken relative to the bone are only to obtain an apposition of the fragments and so to "suture" them that the reduction may be maintained while the external splint is applied and also to some extent to counteract the tendency to displacement along the fracture line which may result through muscular pull and through ordinary movements of the extremity, in nursing. That this very important fact is overlooked or considered unessential is shown in the literature as but few writers after describing their method of fixation make any mention of an added external splint. Is it not feasible to state that many of the failures in internal fixation operations have resulted from the lack of external splintage rather than from a defect in that part of the operation directed to the bone alone? Have not many plates and bands become loose and irritating foreign bodies as the result of necrosis due to the added strain thrown upon the fixation device through inadequate external fixation? Is it proper to teach that a fractured leg can be banded and the patient allowed to walk within a few days without additional external support?

HISTORICAL REVIEW

The earliest reference to the use of wire for suturing a fracture is that of Icart in 1775. Icart had been accused in a letter by Pujol of using a wire on a fractured leg which resulted in the death of the patient through gangrene 2 d s later. Icart in his response to Pujol vigoro y denied that he had used wire though he would t have had an objection to it in a fracture in w h the periosteum and soft parts had been torn a . He then goes on to state that Lupujade and S e of Toulouse had used wire in their fracture w . Pujol replied to this, stating that he had wor l as an assistant to these two men and indigna refuted the statement, saying that they would t be guilty of such! Heard, in 1839, in an ar e on ununited fractures refers to the fact t Kearny Rodgers had drilled holes in the end f bones after resection and united the fragme s. Pancoast, in 1844, in his *Treatise on Opera e Surgery* states that wire sutures should not e used in fractures as it causes bone necrosis a f, later, in his 1852 edition, mentions that wire h d been used in fracture work at the Pennsylva a Hospital years ago but with unsatisfactory re sults. Severine was quoted by Velpeau as hav g suggested, in 1839, that a fracture of the pate la be wired but that the patient refused the opera tion. Apparently but little was suggested for many years in the way of methods of holding fractures other than through simple splints. Le Moyne reported in 1879 the successful treatment of an ununited fracture in which he maintained proper approximation of the fragments by means of a "staple" type of clamp and a double splice of wire. In 1878, von Heine used a rather elaborate contraption for holding ununited fractures. In 1840, Flaubert, as quoted by Malgaigne, successfully united a fractured humerus by passing a metal wire through the ends of the bone. In 1840, Malgaigne presented his hooks (Fig. 1) for maintaining apposition of the fragments in a fracture of the patella. These hooks were later modified by Levis who made them in pairs, by Otis who had the parts adjustable, and by Dup y who used heavier metal. Gaillard, in 18 , treated his fractures by means of long scre s (Fig. 1) which were passed through the skin a l the bone, the shaft of the screw being in silv r sheaths as it passed through the soft tissues. 1886, Bircher used intermedullary plugs and a a special clamp for holding fractures. Wright, 1885, reported 8 cases in which wire was used a bone suture. In 1887, Bernays created thin bo

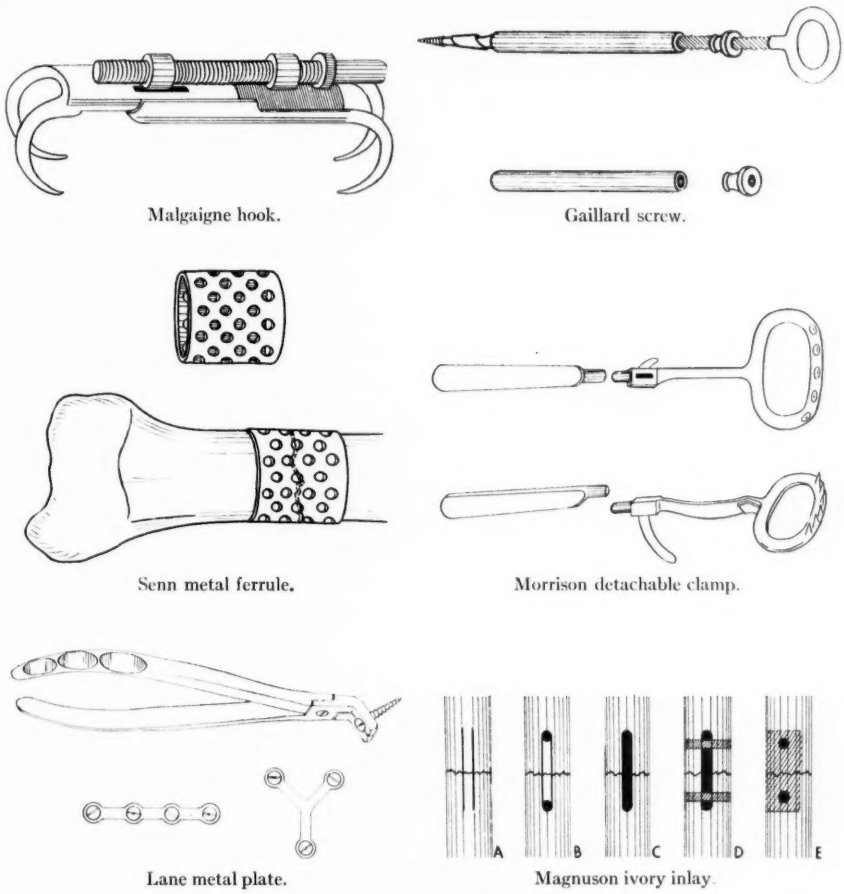
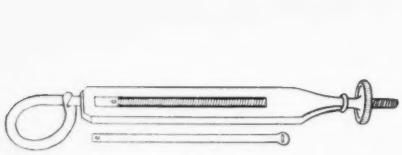


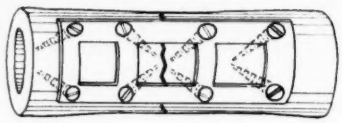
Fig. 1. Different types of apparatus.

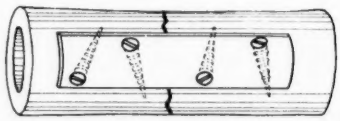
plates by implanting bone sawdust into the abdominal walls of a dog and then using these plates about the line of a fracture, the plates being held in place by means of wire. Keetley, in 1892, used adjustable staples which transfixed the bone and then were fixed externally in the plaster splint. Senn, in 1893, suggested the use of a perforated ferrule (Fig. 1) over the fracture line. Thiriar reported, in 1894, 2 cases of pseudo-arthrosis in which he used with success aluminum plates fixed by screws. He stated that Quénu of Paris had used such plates in 1891. Estes (33) in 1896 reported the use of steel plates of his own devising which were held in place by means of ivory pegs and that he had used this method of fixation of fractures since 1887 and also mentions that Schede of Hamburg had used similar plates at an earlier date. In 1900, Streinach reported his method in which silver plates were used. Annandale described, in 1897, his pin method and, in 1902, Lambotte reported his work with transfixation screws held together by means of an external plate (Fig. 2) and in, 1909, Morrison published his article describing a special bone clamp with detachable handles (Fig. 1).

Until Lane (63) in 1905 (Fig. 1) gave out his work on the use of metal plates fixed to the bone with metal screws and described his technique of operating, the use of metal for fixation of fractures had been more or less sporadic and sug-

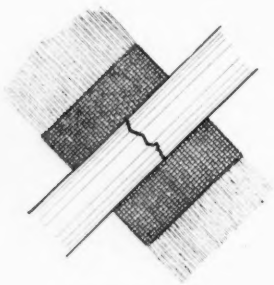


Parham-Martin metal band.

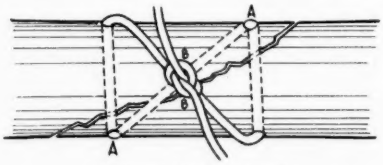




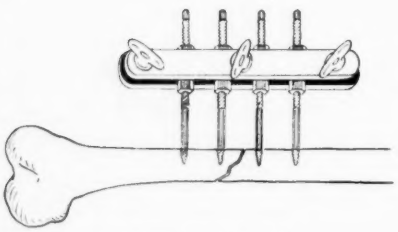
Hey-Groves metal plate.



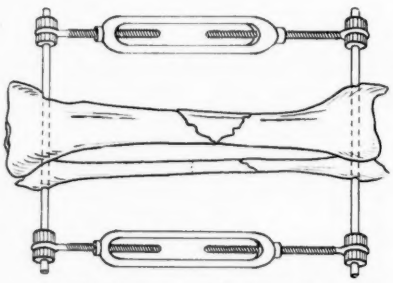
Straus catgut mat.



Patterson fascial sutures.



Lambotte external plate.



Hey-Groves transfixation bolts.

Fig. 2.

gested by only a few operators. Lane not only stimulated open reduction of fractures by showing that it was a comparatively safe procedure so far as infection was concerned but also satisfied to a large degree the surgical world that the use of metal in the line of fracture did not prevent normal bone healing. The pendulum swung far, and Lane plates became a part of the surgical equipment of every hospital and a text on fractures was not complete without a full picture of the different size Lane plates and the special tools for their application. In 1912, further stimulus was given the subject of internal fixation of fractures through the writings of Buchanan, Sherman, Hey-Groves (51), and Allen (3), to be followed the next year by the reports of methods by Scuttar, Magnuson (Fig. 1) and Freeman (38). It was for the year 1914 that the literature reserved its full glory of new ideas in fracture work. Milnes (84), Putti, Parham (85) (Fig. 2), Brougham, Davison, Straus (Fig. 2), and many others made their reports. New devices, new material, and newer improvements! The year 1916, too, had its share of contributors to this subject in the articles by Hawley, Lathrop, Kane, Grant, and Robert; in 1919 Collins (20), and Bell; in 1920, Hughes and Smith; and, in 1924, Eliason wrote of the experience with internal fixation methods. In 1927, Digby and Trojan started a fresh outburst of writings upon open operation of fracture for in 1928 Juvara, Hendon, Patterson (Fig. 2) and Cucullu added articles to the literature to be followed in 1929 by those of Henderson, Greenwood, Bailey, and Allen (4), and in the next

years Dahl-Iverson, Conn, Pitkin, Carrell, and Knickerbocker added their contributions to the subject. (Apology is made to those many tens or even hundreds of authors whose writings have been apparently overlooked in this review.)

At the first glance of the literature on the subject of "internal fixation" of fractures, the problem would seem very complicated. A more careful analysis, however, makes it possible to simplify the matter, and the confusion of so many methods (the writer was able to isolate 62 different methods or modifications of methods from the articles reviewed and many more have been presented only through the literature of the instrument maker) resolves itself into two general underlying principles, that of the use of an absorbable material and that of the use of a non-absorbable material. In each group there is one common factor, the use of a material which is foreign to the body tissues (with the exception perhaps of those who use autogenous bone or fascial sutures for fixation purposes). It is obvious that those who use a material which is absorbable must place that material in contact with the bone and that the soft tissues are closed. To those who use non-absorbable material is offered the plan of buried material (bands, plates, etc.) which should be removed by a second open operation or the plan of devices which transfix the bone and extend through the skin that they may be removed without further operative work (long screws, transfixation pins, special clamps, etc.).

OPEN REDUCTION OF FRACTURES

It may be noted as a maxim that in fractures of the long bones, an earnest effort should first *be made to obtain reduction through simple or closed operation* and *open reduction be done only after the simple method of reduction has failed to give a position satisfactory for good function.* This does not necessitate a perfect position of the fragments as shown in the X-ray.

Fractures of the patella and olecranon with wide separation of the fragments, fractures of the tibial condyles with a disturbance in the joint level, fractures of the vertebræ with cord lesions, certain fractures of the ulna and radius (upper fourth), fractures about the joints with small fragments displaced (elbow), and some depressed fractures of the skull constitute a group of bone lesions in which open operation is the only plan of treatment and should be done early.

With the better understanding of skeletal traction and the use of the fluoroscope in closed reduction, the indications for open reduction are becoming less frequent. However, with better surgical technique the dangers of exposure of the fracture line are so minimized that one should not hesitate to open a fracture in order to obtain that position which will give the best functional result. It should be noted that an open reduction will, in the majority of cases, lengthen the time for complete healing of the fracture.

THE REACTION OF BONE TO METAL

The effect of metal on bone and on the formation of callus and on the eventual healing of fractures has been a subject of considerable study and discussion, with the question still one of dispute and controversy. Zierold quotes the work of Levert who made experiments upon dogs to determine the tolerance of bone and soft tissues to metal sutures. He used gold, silver, lead, and platinum, finding the latter to be the least irritating.

Leriche and Policard (also quoted by Zierold) conclude from their studies that "by histological examination and chemical analysis of the tissues involved, not only was the bone adjacent to a buried steel plate necrotic and rarefied but that there likewise occurred a marked impregnation of the underlying structures with iron salts." Mann found only a slight rarefaction around steel nails and screws at the end of 4 weeks.

Hey-Groves (52), in a large series of experiments, came to the following conclusions: (1) nickel plated steel has no irritating effect upon tissues; (2) magnesium is rapidly absorbed and acts as a powerful stimulant to bone formation; (3) indifferent aseptic foreign bodies are readily tolerated by the tissues.

Zierold's conclusions in his own work are summarized thus: (1) Gold, aluminum, and stellite are readily tolerated by bone and tend to become encapsulated with but little hindrance to the reparative processes. They are inert materials unaffected by the living cells and body tissues. (2) Silver and lead are only slightly less tolerable to bone but are easily corroded and evoke a slightly greater connective tissue response. (3) Zinc goes into solution readily and causes a slight connective tissue stimulation. (4) Copper causes definite stimulation to bone production. (5) Copper aluminum bronze frankly interferes with bone regeneration and tends to become extruded. (6) Steel, and, to a less degree, iron definitely inhibit bone regeneration. Steel which is poorly tolerated and readily soluble seems least suitable for all bone prothesis. He differs with the findings of Hey-Groves in that (1) nickel has a distinctly injurious effect upon bone growth and that it is soluble in the tissues which make no attempt to

retain it and (2) that magnesium is a slight connective tissue stimulant and, if anything, tends to retard bone proliferation.

Brickner gives the following deductions: (1) A metal plate screwed to a fractured bone can, of itself, cause delayed union and non-union and (2) neither a 3⅝ inch metal plate nor an additional well applied plaster-of-paris splint can be depended upon to maintain alinement of a fractured shaft in a very muscular thigh.

Magie states that a metallic band causes an excessive callus, and Stanley and Gatellier also found the same reaction to metal bands. In the use of metal plates fixed with metal bands they found the latter were not incorporated in the callus formation. Leriche and Policard (71), in 1920, studied 15 cases of osteosynthesis by means of Lambotte's plates. Microscopic examination showed a certain amount of fibrous tissue external to the plate. Around the plate was at times noted a sheath of new bone, while beneath the plate the bone immediately subadjacent is dry, white, and avascular. If the plate were removed early (20 to 90 days) they found an extremely thin lamelliform sequestrum. Further study showed an ischæmic necrosis and, deeper, the bone in a process of rarefaction. The central callus was slow to appear and poor at that and the tissues impregnated with iron salts. Millet had somewhat the same findings. He attributes the superficial necrosis to ischæmia produced by compression and the destructive action of the body fluids attacking the metal.

Cunèo and Rolland found that organic salts formed about metal but that it had no deleterious action upon the tissues, bony or otherwise. Young stated that plating does not prevent delayed or non-union and suggested that the periosteum be reflected from that area to which plates are applied in order to encourage callus formation. Relative to the use of plates Frank gave these conclusions after a review of the literature upon this subject: (1) Plates do not always fix the fragments as the screws are often enough loosened by aseptic rarefying osteitis. (2) Plates do not act as trestle work. On the contrary they cause destruction of the adjoining osseous tissues. (3) Plates do not stimulate osteogenesis but he believes that the primary firm fixation is a distinct hindrance to new bony growth. (4) There are too many unfortunate sequelæ resulting from bone plating such as persistent sinuses and the stiffness in neighboring joints.

Freeman (38) believed that the presence of a foreign body near the line of fracture favored delayed union or non-union, to say nothing of infection. He quotes Martin thus: "As a rule the presence of a plate instead of stimulating osteogenesis between broken bone ends retards it." Lathrop was led to the use of the sliding graft through his experience with plates which required removing or caused non-union, softening, and necrosis. Harrigan advocates the use of plates in certain types of fractures but feels that the ideal fixation apparatus is one made of an absorbable material. He admits the validity of the objections to the use of plates in that they delay callus formation and bone union. Bartlett at first was enthusiastic about the use of metal plates but, after reviewing 38 cases in which the plate was removed in 13 cases and 7 cases had failure and also finding that in the course of time bone in contact with metal disappeared, is now more conservative in their use.

Albee, Hessert, Lexer, Henderson, Harrigan, Frank, Freeman (39), Lathrop, object to the use of metal plates and for the most part to the use of metal in any form for fracture fixation. Sherman, Lane (64), Hey-Groves, Eliason, Ashhurst, Halsteau, Dujarier, Fredet, and Algrave, on the other hand, form a group who have used metal plates extensively and with gratifying results. Many surgeons who object to the use of plates but not to the use of metal have developed their own special devices of bands, clamps and transfixation pins with external plates.

FIXATION DEVICES AND APPARATUS

In the earlier years of surgery but little attempt was made to do any open reduction of fractures on account of the danger of infection. Malgaigne (Fig. 1) invented his hooks for drawing together the separated fragments of a fractured patella which device was later modified by Bérenger and also by Rigaud. In 1878, von Heine published his results with a rather complicated apparatus which evidently did not meet with approval. Gaillard (Fig. 1), in 1865, used a long screw extending through the skin and transfixing the bone along the line of bevel of the fracture. These screws were removed after healing of the fracture.

In later years open reduction of simple fractures was proved to be a safe procedure and the use of bands and plates became more or less universal for fixation purposes. The disadvantages of these devices, especially the necessity for a second open operation as well as the thought that they did not meet all conditions and also may lead to disturbances in callus formation, together with that human desire to "invent something new or different" led to the creation of many

types of contraptions which would control the position of the fragments but which could be removed without discomfort to the patient. The number of these bone "fixation" methods are innumerable. Figures 1 and 2 show a few of the many methods.

ABSORBABLE FIXATION MATERIAL

The use of an absorbable material for suture of fractures is theoretically the ideal plan of treatment but practically presents some difficulties which prevents its use.

Catgut and kangaroo-tendon. In certain simple conditions, the use of a single, simple suture of catgut or kangaroo tendon is of great advantage especially in the replacement of small fragments such as the epicondyles of the humerus. In fractures of the shaft such a suture can be of but very little value as the fixation or retention force is exerted only in that narrow axis represented by the direction of the plane of the suture. The presence of either material does not retard bone repair. The kangaroo tendon may act as an irritant and lead to a sinus formation.

Beef bone and ivory. That bone would tolerate the presence of ivory and that this substance might in some stimulate the formation of callus was suggested by Dieffenbach in 1846. In a case of delayed union, he drilled holes near the ends of the fragments and put in ivory pins which projected through the skin and were later removed. In 1879, Socin and Burchardt drove ivory posts into the fragments of an ununited fracture and "had union finally." In 1887, Bernays attempted experimentally to hold a fracture by means of bone plates which he obtained after implanting bone sawdust into the abdominal walls of a dog. In 1913, Magnuson reported his results with the use of ivory plates and screws, stating that ivory was acceptable to human bone tissue, that it did not cause softening of surrounding bone, was gradually absorbed, and did not become loose, since the bone grew in as the ivory is absorbed. In his method he used a "key" plan in which the ivory plate was set in a slot cut through the cortex so that its plane would be at right angles to the greatest tendency to displacement of the fragments (Fig. 1). In 1914, Brougham published a preliminary report on the use of beef bone plates which were attached to the side of the bone by means of screws. In 1927, Boliarsky suggested the use of cow horn in the manufacture of plates. In the same year Henderson presented his work on the making of beef bone plates and screws which he considers preferable to other types. Bailey, in 1929, reported the use of beef bone plates in 39 cases and Greenwood, instead of screws, used as a modification square pins driven through the cortex. The following year Dahl-Iverson described a special plate tied on to the shaft of the bone by strands of an absorbable material.

Intermedullary pegs. The earliest reference to the use of an ivory intermedullary peg is that of Bircher, in 1886, but apparently nothing along this line of fixation was further suggested until in 1912 when Hey-Groves (51) advocated the use of such a peg made from beef bone. In 1914, Davison reported that he had used autogenous bone plugs in the medullary canal with success. This type of fixation has had at times supporters especially Hendon and Allen but so many unfortunate results have been reported that perhaps these pegs should be used only as a last resort, although mechanically they are ideal for this purpose. Davison and Christopher as a result of their experimental studies in the use of beef bone intermedullary pegs gave these observations: (1) That part of the boiled beef bone which remains in aseptic stable contact with the endosteum of its host, surrounded by living bone, becomes solidly embedded in new bone. The peg undergoes gradual absorption and is replaced by living bone which later, in turn, is absorbed. (2) That part of the beef bone which lies between the fragments, but not protected by endosteum and not covered by living bone, even with aseptic surroundings, undergoes rapid absorption and disintegration and is not replaced by new living bone. (3) When one end of the beef bone is not fixed in stable contact with the endosteum but remains in position, there is gradual absorption of both the peg and the surrounding bone. (4) That the internal callus, when the mechanical fixation holds and is aseptic, is limited by the beef bone and does not bridge the line of fracture. The external callus is markedly lessened and the permanent or definitive callus is inhibited. (5) That the series of experiments did not produce a single successful anatomical and functional result. (6) That the causes of failure were (a) infection which was frequent and usually fatal, (b) disengagement of the peg due to failure of mechanical reduction or to lack of continued immobilization or to loosening of the repair by absorption of the peg and the surrounding live bone, (c) disintegration of the peg from absorption at the line of fracture. A repair apparently mechanically perfect would show a good result as long as the peg remained strong enough to support the bone. When disintegration of the peg occurred at the line of fracture a point of mobility

would be found. The end-result of their experiments were either a permanent non-union or lateral union usually in malposition.

In 1916 Kane suggested the use of a metal scroll which was introduced into the medullary canal wound rather tightly. It was then drawn down across the line of fracture and the retaining strand loosened to allow the scroll to unwind.

Sliding grafts. Albee and also Buchanan, in 1912, suggested the use of a sliding graft for fixation purposes in fractures which, in 1932, was modified by Fœrster to make the graft fit more snugly. This method has been used perhaps more in delayed and non-union cases than in fresh fractures.

Fascial sutures. The use of fascial sutures has apparently not been adopted to any great extent, no doubt due in a large part to the fact that a second incision must be made leading to the possibility of infection and to the scarring of the skin. Patterson (Fig. 2) and Roberts have reported such methods and recently Ober has suggested the use of a part of the quadriceps tendon for the repair of a fracture of the patella.

From the many different methods suggested for holding fractures in position at time of open reduction there has not been any one plan of operation nor any one type of material nor any one device which has been universally adopted by the fracture surgeons. As stated previously there has developed two groups or schools of thought, one in which absorbable material is used and one in which non-absorbable material is used to hold the fragments. The latter group is further subdivided, one group using a buried fixation apparatus (short screws and nails, bands, plates) which demand removal through a second operation and one group using devices which transfix the skin and soft tissues (long screws, transfixation pins and bolts, special clamps) to be removed without further operation.

The criticism of all methods for "internal fixation" of fractures is practically the same for each method and is based either upon the reaction of the body tissues to foreign material or upon the difficulty of the application of the fixation device to the bone. All the methods suggested so far require special material and special instruments, necessitate to a large degree some experience in the technique of application and thus are not open to the average surgeon, and further lead to long operations and to a considerable trauma to the tissues. No one method is applicable to all types of fractures and thus the operator must have several different kinds of apparatus and be able to apply them as indicated when the fracture line is exposed. In the use of the non-absorbable material there are the added disadvantages of a second operation for the removal of the metallic device, the danger of unfavorable reaction of the tissues resulting in infection, sinuses, delayed union and non-union, and also the frequent breaking of the metal or its loosening from the cortex of the bone.

INTRAMEDULLARY SPIKE OPERATION

With the hope of overcoming all of these disadvantages and objections which have been made to the many methods of operation and to the many types of devices for internal fixation of fractures a simple procedure is herewith offered. It cannot be called a "new" operation for doubtless the principle has been used frequently but only when the conditions found at the time the fracture line was exposed made its application possible. Originality must perhaps be accredited to Roux, who in 1833 "resected a fracture and inserted the tip of one end of a fragment into the medullary cavity of the other fragment" (Bérard). *That the suggested plan of operation can be used as a definite line of attack in all open reductions of fractures may be offered as a new thought.*

In this simplified operative procedure for fixation of fractures requiring an exposure of the fracture line, all foreign material is eliminated, no special instruments and special material are required, the danger of infection and sinus formation is limited to that of any simple open operation upon a fracture, any type of fracture at any point on the shaft of a long bone, even close to a joint (with the exception of one badly comminuted), may be reduced and securely fixed until external splintage is applied, traction apparatus is not required, the length of operative time is lessened, the trauma to the tissues is minimized, the skin incision is short and the operation can be performed by the average surgeon in any operating room suitable for bone work. It does not influence the formation of callus and bone healing other than that which occurs in all open fracture work, an added 2 or 3 weeks for solid union. It can be used in compound as well as in simple fractures and in selected early cases of non-union one may expect union without the use of some type of bone graft.

The operation is based upon the simplest of mechanical principles and physical laws (Fig.). When the shaft of a long bone is fractured without comminution, the fracture line may be smooth and straight but, in practically all instances, one will find that the ends of the fragments are serrated in varying degrees. If a perfect reduction is

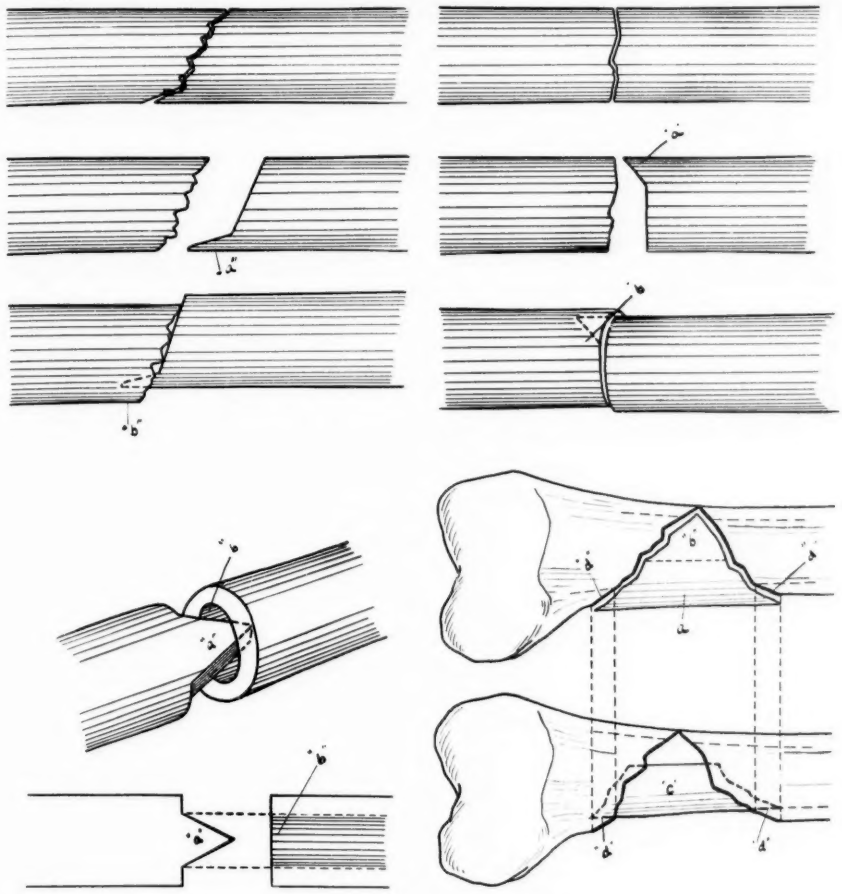


Fig. 3. Intramedullary spike operation.

obtained these serrated surfaces will fit and dovetail one into another thus giving a complete restoration of the contour and shape of the bone. Rarely, however, is the fixation which comes with this perfect reduction of sufficient strength to maintain the position of the fragments against the ordinary handling of the limb or against the normal physiological pull of the muscles, and the reduction is lost. It is impossible in such a fracture line further to increase the fixation of the fragments by introducing any of the serrated points on one fragment into the medullary cavity of the other fragment as the bevel of the fractured end will impinge against the bevel of the other end. Nor will impaction of one fragment into the other fragment be possible on account of the density and solidity of the cortical rim of the bone. Even in comminuted fractures one will find it almost always impossible to impact the fragments or to insert a point of one fragment into the medullary canal of the other on account of the impingement element.

It is, however, possible to form a spike upon one fragment which can be used as an intramedullary fixation by cutting back the bevel of the circumference of the cortex a distance of one-quarter of an inch with the exception of that portion of the cortex which constitutes the base of the spike. It is upon this simple principle that the proposed operation is based. It is applicable

for a transverse or a spiral or an oblique fracture and with slight modification can be used in certain types of comminuted fractures.

DETAILS OF OPERATION

The skin in the operative field is prepared the day before and the day of the operation by thorough scrubbing with green soap which is removed with alcohol and then ether and the parts covered with a sterile towel. At the time of operation the prepared field is outlined with a weak solution of iodine. The skin incision need not be long and the fracture line is exposed by careful dissection with as little trauma to the soft parts as possible. That fragment of the fractured bone which comes easily into the operative wound is grasped with bone forceps and the longest spike or digitation is noted. It is necessary neither to examine the end of the other fragment, for it will conform in contour to that fragment fully exposed, nor to strip back the periosteum or to disturb in any way the muscular or septal attachments. With a heavy rongeur the rim of the cortex of the fragment is cut back a distance of one-quarter of an inch except at that point which will form the base of the spike (Fig. 3). The base of the spike should be the same width as the diameter of the intermedullary canal of the other fragment. The other fragment is then grasped with a bone forcep and brought into the wound so that the prepared spike can be inserted into its medullary canal. In most fractures there is an overriding of the fragments and, when the fragments are approximated, one will find that the spike is pressed into place thus giving a firm fixation. The wound is then filled with ether, the muscles and soft tissues carefully sutured with plain catgut, and the skin closed with some non-absorbable material (dermol or silk). If a fracture table is available the limb should have been fixed so that the splint can be applied without any movement of the bone. If it is necessary to have an assistant hold the leg, he should be instructed not to exert traction upon the extremity but gently to push the lower fragment against the upper fragment in order that the spike be not disengaged from its position in the medullary canal and the reduction lost. A very efficient plaster-of-paris splint is then applied to prevent any motion in the line of fracture, a splint as efficient as would be required had not an open reduction been made. This feature is most important and again it should be emphasized that there is no "internal fixation" but only a suture of the fragment and that fixation is dependent entirely upon the external splint.

A type of fracture which presents some difficulty in fixation is that in which there is found a comminution with a rather large triangular fragment involving the entire diameter of the bone (Fig. 3). The contact of the main fragments of the shaft is represented by a small portion of the rim of the cortex. A study of this type of lesion will show that the base of the triangular fragment is longer than the greatest distance between the ends of the medullary canal in each fragment by that length represented by the shear or bevel of the cortical portion of the bone. It is impossible to insert this triangular fragment into the medullary canal on account of the impingement of its edges and by the apex of the fragment. By removing the upper half or the apex portion, one has a piece of autogenous bone which can be used as an intermedullary peg and which will have for its fixation element that length given by the bevel on the cortex. If this is found to be too little, then a quarter of an inch can be cut off the end of one of the main fragments. By this means an efficient fixation is given which, being autogenous, will not affect in any way the healing process along the line of fracture.

A discussion of the treatment of compound fractures is not within the scope of this article. The writer's personal experience in this type of lesion has led to a plan of operation which is based upon complete careful débridement with closure of the wound without drains. In all cases in which a metal fixation device was used infection followed. With the "intramedullary spike" plan the same fixation of the fragments can be obtained as would be obtained in the open reduction of a simple fracture. In none of the compound fractures thus treated has there occurred a non-union of the bone.

In fractures with considerable comminution it may be impossible to use a medullary spike without producing too much shortening, and skeletal traction must be used. This is the only type of fracture in which the writer's method is not applicable.

In fractures near the end of the shaft in which the medullary cavity is absent in the distal fragment, it will be necessary to cut with a chisel a hole in the solid bone to receive the spike constructed on the other fragment.

Criticism of the medullary spike operation may be directed to two points, that of shortening of the extremity and that of angulation at the line of fracture. The shortening of the bone should not exceed one-quarter of one inch. In the upper extremity in the humerus this amount of shortening is not a source of disability and can be dis-

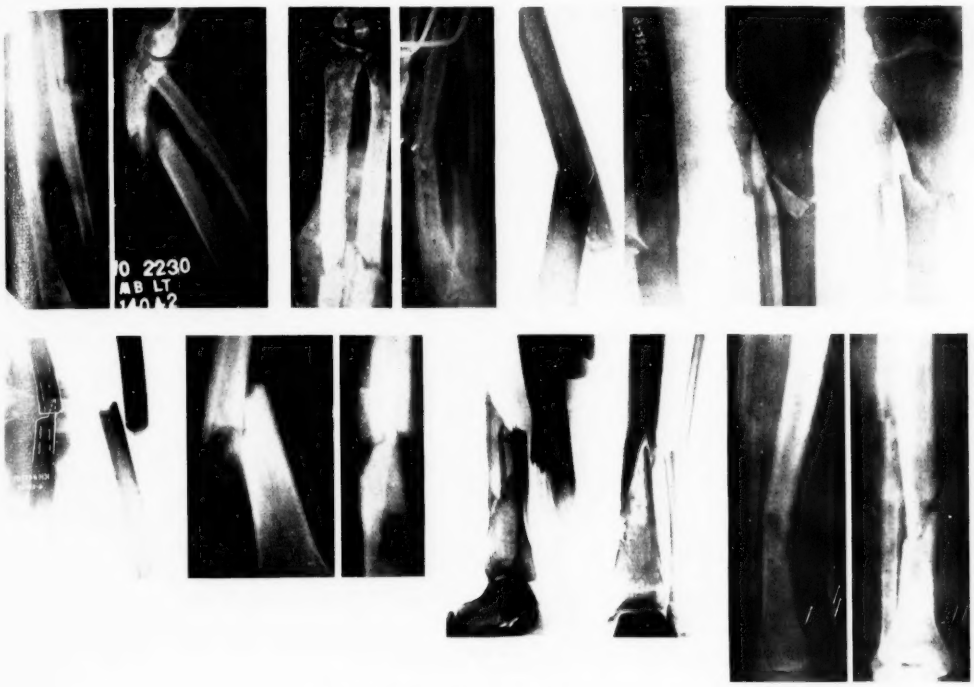


Fig. 4. Roentgenograms of author's cases.

regarded. In the lower extremity a shortening of such a degree is again not a source of impairment or disability and can be easily corrected by a lift on the heel or accommodated by a tilt of the pelvis without causing a scoliosis. In the forearm the writer believes that traction is essential in any form of treatment, be it that of closed reduction or that of open reduction with some type of internal fixation. The muscle strains and pulls which are peculiar to the forearm make this element in treatment a necessity. In the medullary spike operation traction is not applied, in adults, for the first 2 weeks. At the end of that time the callus formation is sufficient to prevent displacement of the fragments through the use of that amount of traction needed to prevent angulation. The splint is changed at this time and some type applied which incorporates traction principles.

The control of the angulation in the shaft is not a difficult problem in the humerus or the femur or the tibia. At the end of 10 to 14 days the plaster splint can be so cut at the fracture line as to form a hinge at the apex of the angulation. Under the fluoroscope the distal fragment can be brought into alinement with the proximal fragment by merely bending or hinging the splint and again fixing it in the desired position by a few turns of a plaster bandage.

The intramedullary spike operation has been the writer's plan of treatment in open reduction for a period of 5 years. There have not occurred any instances of non-union nor any complications leading to a disability other than that which would have been expected had a simple reduction been made of the fracture. In several cases of non-union which were seen before a great amount of ebonation of the bone had taken place, this method was used with success without the added element of any type of bone graft. Figure 4 shows prints from X-ray films.

CONCLUSIONS

1. Open reduction of fractures of the long bones should be carried out only after earnest and repeated efforts by means of simple closed methods have failed to give a position of the fragments which will lead to satisfactory function.

2. Some type of "internal fixation," either of absorbable or non-absorbable material, has been advocated for many years. No one type has been universally accepted.

3. The author's "medullary spike" operation for fixation has many advantages: (1) Simplicity, it can be performed by any competent surgeon; (2) no special instruments other than a bone rongeur are required; (3) no foreign material is used; (4) the method is applicable to any type of fracture and at any portion of the bone (near joint); (5) a very short incision can be used; (6) there is a minimum amount of trauma to the soft tissues and to the bone; (7) no second operation is necessary; (8) union is delayed not more than in any open reduction; (9) traction is needed only to prevent angulation; (10) the method can be used in compound as well as simple fractures.

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THE FLAP OPERATION FOR THE TREATMENT OF ACUTE EMPYEMA THORACIS[1]

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THE operation described below has given us such good results that it merits description. Like many excellent things its origin with us was due to accident: an intended open drainage of the chest was done in such a way that the incision was not quite straight, and the rib which was resected was not immediately beneath the skin incision but a space above it. This resulted in a rudimentary flap which acted for 24 hours as a valve, at the expiration of which time nature corrected the mistake and open drainage was secured. The idea was seized upon, however, and through many stages of experimentation and development the present flap operation was perfected by the writer. The work done with this beginning started in 1915, and the operation as at present done was more or less standardized in 1917. Since that time minor modifications have been made from time to time but the essential features have not been materially altered. Work by myself and associates during the War, and since, has convinced us that the operation has unusual merits.

A brief résumé of the last 35 consecutive cases is appended. It will be noted that 17 cases were in children, the ages varying from 4 months to 14 years of age. One child, 2 years old, died; the rest recovered promptly and completely. In the 18 adult cases there were 2 deaths; in one patient (Case 22) it was felt that the pleural condition was but a part of a generalized and overwhelming infection, and operation did not influence, for better or worse, the course of the disease. In Case 26 patient came to the operating table with a massive, concealed, gastro-intestinal hæmorrhage which became manifest immediately after operation; in spite of a completely satisfactory pleural response to operation the patient died 5 days after operation of uncontrollable gastro-intestinal hæmorrhage. In 5 cases the acute empyema complicated definite lung abscess; all made good recoveries with complete healing of the pleural lesion (Cases 7, 14, 17, 21, and 23). All patients were operated on as soon as seen in consultation, which was usually immediately after the diagnosis was established, without regard to the organism present or the condition of the pleural exudate; the criterion of "thick or thin pus" was discarded for the older—and better—surgical principle:—*ubi pia, ibi evacua*. Pre-operative paracentesis was diagnostic only—as soon as it was felt that the patient's condition justified *any* mechanical interference, the flap operation was done. Case 23 was an exception to the dictum of immediate operation: he was seen after a protracted siege of several months of lung abscess, and he appeared to be so altogether fragile, emaciated, and exhausted by prolonged sepsis that *any* operative procedure must be followed promptly by death. He was seen daily for one week during which time every effort was made to make him operable; at the end of this week he appeared worse, if possible, and with the feeling that there was nothing to lose he was operated on, made prompt improvement, and went on to eventual recovery from his acute empyema. This man had three distinct, probably intercommunicating, abscesses: the entire pulmonary picture had a background of tuberculosis which has since been definitely established.

Treatment is carried out along the following lines:

Diagnosis. Diagnosis is established by the usual methods of clinical examination, with due emphasis upon the use of the X-ray.

Position of the patient. The patient is placed upon the operating table and turned partly upon the sound side; the arm on the affected side is abducted, the hand resting palm down upon the table beside the face.

Anæsthesia. The anæsthesia for the adult is novocain in 1 per cent and 2 per cent solution. The children are given ether, open drop, after preliminary morphine and atropine in suitable dosage.

Selection of the site of rib resection. The rib to be resected is chosen by careful clinical and X-ray examination: the most dependent portion of the cavity, with the patient in the sitting position, at its posterior or mesial border, is mechanically the ideal spot for drainage; actually, and practically, the opening into the chest is not possible at this point, nor is it necessary as experience has shown. Except in the unusual case the rib to be resected is the eighth, and the spot at which resection is made is in the region between the posterior axillary line and the line of the angle of the scapula with the arm at the side. It is not wise

[1]Read before the Waterbury Medical Association, Waterbury, Connecticut.

as a rule, to go lower than the eighth rib, certainly not lower than the ninth, because of interference with drainage by the rising diaphragm. If a rib higher than the eighth is resected the relation of the opening to the scapula in all its positions must be considered or drainage may be blocked by this bone.

The flap. The point at which the rib is to be resected is taken as the center of the base of the flap, and anæsthesia, in the adult, is induced by local infiltration and field block with novocain solution 1 per cent. The production of four wheals along the proposed lines of vertical incision, and three wheals on the lower connecting horizontal incision, aids in the distribution of the local anæsthetic. The incision is U-shaped with rather sharp angles. It begins 2 inches mesial to the center of the base of the flap, is carried vertically downward for a distance of 4 inches, turns abruptly laterally and is carried horizontally for a distance of 4 inches, then turns abruptly upward and is continued vertically to end at the level of the center of the base of the flap, and 2 inches laterally from that point; this outlines a flap 4 inches across at the base, 4 inches across at the apex, and with parallel vertical sides 4 inches long (Fig. 1). The incision is carried through the subcutaneous fat to the fascial plane of the back. The entire skin flap, with its attached subcutaneous fat, is now elevated to a point a little above the site of the intended rib resection (Fig. 2). The portion of the rib to be resected is chosen carefully with regard to its position in the exact center of the base of the flap; because of the elevated and abducted position of the arm on the affected side it is wise to choose a point a little mesial to the apparent center. Occasionally the latissimus dorsi will interpose some fibers at this point and if this is so the interfering portion of the muscle is blocked with novocain and resected between clamps (Figs. 2 and 3). The portion of the rib to be removed is exposed and the subperiosteal tissue is infiltrated with 2 per cent novocain solution for a distance of 2 inches. One inch of rib is resected subperiosteally (Fig. 3). We found that, in the adult and conscious patient, a simple expedient spares the patient the shock of the sound of rib resection; with the costatome in position he is encouraged to chew a few lumps of ice, and while he crunches, so does the surgeon. This little trick serves as a really valuable psychic adjuvant to local anæsthesia. Hæmostasis is now attended to. The parietal pleura is injected with 2 per cent novocain solution and is incised for a distance of three-fourths of an inch; as the pleura is incised the index finger is immediately

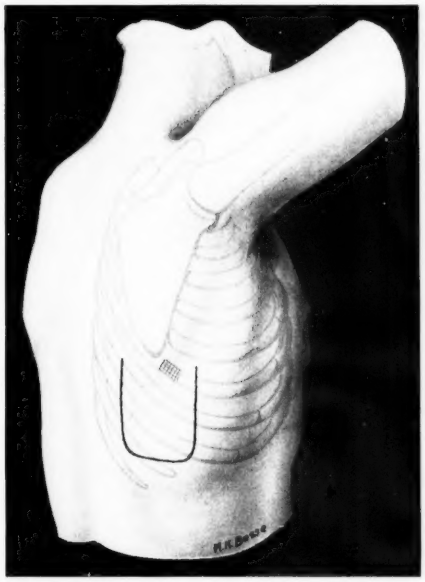


Fig. 1. Showing outline of flap and its relation to resected portion of rib.

introduced, thus plugging the opening and preventing both the emptying of the chest and the ingress of air to the pleural cavity. An empyema button—prepared by attaching to the lower half of its outer flange a piece of rubber dam 1½ inches wide, split up to within 1 inch of the flange, and through which a strong "removal string" of braided silk is threaded (Fig. 4)—is introduced during expiration (Fig. 5) and the entire flap immediately replaced and pressure made by the finger of an assistant upon the skin overlying the canal of the button, preventing or impeding the escape of pus. The wound is now closed with a single suture at the midpoint of the horizontal arm, on each side of which the fish-tailed rubber dam is brought out, the "removal string" also emerging beside this suture. The vertical incisions are closed carefully and accurately with a suitable number of Michel clips, one or two clips also being placed in the lateral extremities of the horizontal wound (Fig. 6).

Immediate postoperative care and operative dressing. If it is considered wise to allow the chest to empty immediately the finger pressure on the flap is removed and the flap functions: with expiration or coughing pus is seen to pour out along the rubber dam escaping from the unsutured horizontal wound; with inspiration the

Fig. 2. Flap elevated showing underlying structures and indicating the occasional necessity for resecting the fibers of the latissimus dorsi.

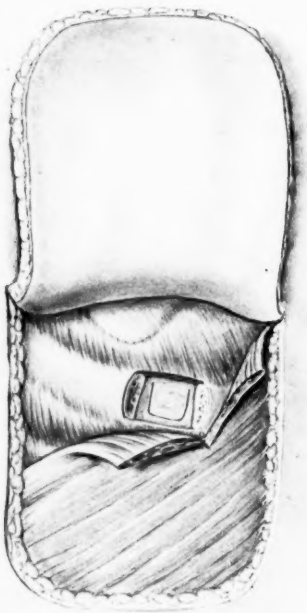


Fig. 3. Latissimus dorsi resected, and portion of rib removed subperiosteally. Pleural incision indicated as a "trap-door." Our present incision is a straight line.

flap instantly plugs the opening in the button and prevents the ingress of air to the chest, and the expansion of the lung is initiated with the taking of the first breath. The simple mechanics of this procedure are illustrated in Figure 7. If the condition of the patient is such that the surgeon feels that a less rapid emptying of the chest is wise a gauze pad is substituted for the finger pressure of the assistant and this pad is held in place by an adhesive strap applied after the dressing of the vertical incisions. This strap can be released from time to time in the first 24 hours after operation, and discarded at the expiration of this period. For the dressing of the vertical incisions a simple form of prepared dressing is convenient: this may be made by padding with gauze a horseshoe-shaped form of cardboard or other suitable firm material of correct dimensions. This is applied with the points downward extending just below the level of the horizontal incision and with the rounded portion of the horseshoe well above the level of the pleural opening. The horizontal portion of the incision is left undressed except for fluff-gauze to catch discharge, no pressure upon this portion of the incision being permitted.

Subsequent postoperative care. The postoperative care consists of replacing the soiled fluff-gauze dressing with fresh gauze as indicated. The patient is out of bed usually within 24 hours. When X-ray examination indicates the complete expansion of the lung the button is removed by traction upon the "removal string." The suture and clips are removed not earlier than the eighth day, and after removal of the clips the vertical incisions are strapped; the granulating areas at the horizontal arm are treated by appropriate applications.

It is our present feeling that we have been overtimid in removing the button and that our present average of 9 days is much too long. The cases complicated by bronchial fistula, as indicated by varying grades of pneumothorax, require that the pleural negative pressure drainage be con-

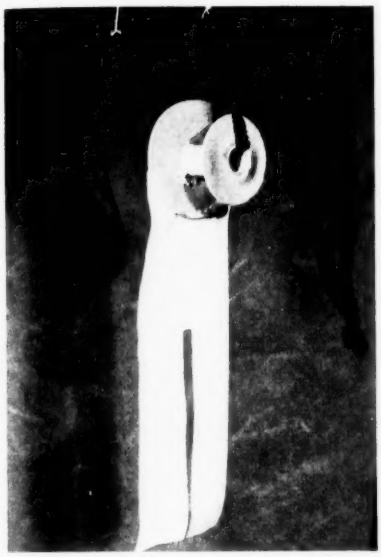


Fig. 4. "Home-made" modification of Wilson empyema button showing stout "removal string" and apron of rubber dam sewed to outer flange of button.

tinued until healing of the pulmonary fistula has occurred, and no time limit can be set. In this group of cases it will be wise to permit the button to remain in place until the pneumothorax has disappeared, or until such time as the surgeon feels that the parietal pleural wound has been sufficiently established to maintain pleural negative pressure until the expansion of the lung has been completed. Lung gymnastics may be indulged in.

The operation described, during its development, has been modified in many ways. In all cases generous flaps and rib resections have been made; the dimensions of the flap as given—four inches by four inches—are suited to the average slender male patient. In the stout patient, and the muscular, the size of the flap should be increased, and in children it may be a little smaller, but not much. It is fatal to the success of the valve action of the flap to err on the small side. Some patients have had no button; some patients have had the unmodified Wilson button; some have had tubes of varying lengths, the outer ends of which have been sutured beneath the flap; some have had rubber dam sutured beneath or to the flap; some have had sutures instead of clips.

In the form described this operation is offered as the best form of treatment of acute empyema

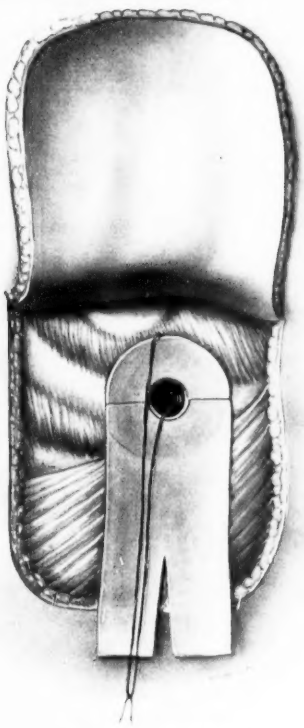


Fig. 5. Button in place.

with which the writer is familiar, for the following reasons:

1. It is *physiological* in that it takes into consideration the normal condition of negative pressure within the pleural cavity, and *respects* it.
2. It is a *closed* method of drainage and *remains so* from beginning to end of treatment.
3. It affords *adequate* drainage because of the generous opening into the pleural cavity made possible by rib resection, with the further "reaming" action of drainage apparatus of our choice.
4. It permits *early operation* in empyema before adhesions in abnormal positions of the lung have occurred, without the dangers resulting from "mediastinal flutter" and *collapse* of compressed lung.
5. It can be done under local anæsthesia in adults; our youngest local anæsthesia patient was 13.
6. Because it is completely a closed drainage it can be done safely in children under ether anæsthesia.

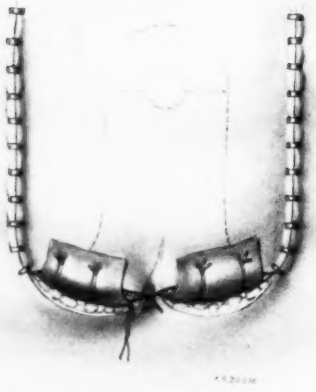


Fig. 6. Flap replaced; showing single median suture in lower portion of flap, with vertical incisions closed with Michel clips, and fish-tailed rubber dam drain emerging from unsutured lower portion of flap, together with removal string.

7. It abruptly cuts short the sepsis due to undrained, or incompletely drained, pus, thus relieving the organs of excretion of their overheavy burden.

8. It shortens convalescence. One of our cases was entirely healed in 10 days, in spite of a chest which held the *maximum* of pus at operation (Case 33).

The following brief case résumés are submitted. They include the last 35 consecutive cases operated on on the First Surgical Division at Fordham Hospital, and in private practice. All patients were operated on by the writer with two exceptions, noted below.

CASE 1. E. F., female, 42 years of age. Operation for intestinal obstruction; 11 days later operation for acute inflammation of the gall bladder, cholecystectomy. Convalescence from second laparotomy complicated by pneumonia. Twelve days after second laparotomy, empyema developed. Flap operation was done on the fourteenth postoperative day: ninth rib was resected; no button was used; general anæsthesia. Subsequent course was uneventful. Cured.

CASE 2. C. N., male, aged 9 years, had pneumonia. On the eighteenth day empyema was diagnosed. Flap operation was done on nineteenth day. Ninth rib was resected; no button used. Recovery was uneventful.

CASE 3. C. L., male, aged 11 years, was admitted to hospital, with empyema. Immediately flap operation was done: eighth rib was resected. Patient discharged 11 days after operation. He returned 6 weeks later with abscess beneath flap. Flap was loosened thus allowing pus to escape. Subsequent recovery was uneventful.

CASE 4. R. C., female, aged 2 years. Diagnosis: pneumonia and empyema. Flap operation was done day following admission to hospital. General anæsthesia was used, ninth rib was resected; no button was used. There was a profuse discharge of pus. Sepsis was unchecked; and patient died 5 days after operation.

CASE 5. C. B., male, aged 11, was admitted to hospital with diagnosis of empyema. Flap operation was done under general anæsthesia. Ninth rib was resected no button. A large quantity of pus was evacuated. Temperature became normal following operation. Recovery was uneventful.

CASE 6. Q. M., male, child, was suffering with empyema. Immediate operation was done, the ninth rib being resected. No button was used. Convalescence was good.

CASE 7. C. W., male, aged 30, was admitted to the hospital with empyema. Flap operation was done immediately. Patient coughed up about 2 quarts of thick yellow pus. He left hospital 14 days later improved but running a temperature of 100 degrees.

CASE 8. G. J., male, aged 14, was operated upon on admission to the hospital for ruptured gangrenous appendix with general peritonitis. Twenty six days later he had left lower lobe pneumonia. One month later a flap operation was done, the ninth rib was resected. No button was used. Twenty-five days later temperature was normal, the wound was clean, and patient was discharged. The infecting organism was the streptococcus.

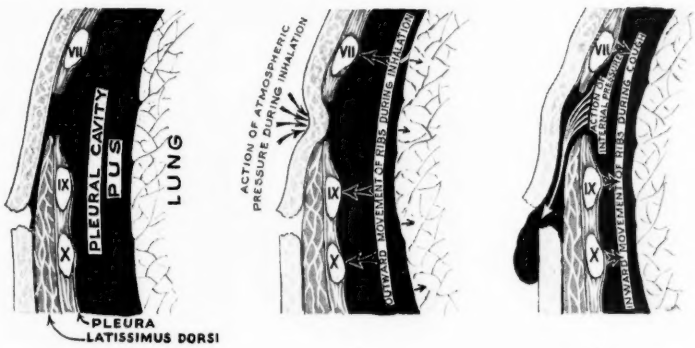
CASE 9. P. M., male, aged 36, was admitted to the hospital with history of 3 months of cough. Two days later paracentesis gave pus from which no organism grew. Flap operation was done under local anæsthesia. The ninth rib was resected. No button used. A rubber dam was sutured to the under surface of the flap. There was profuse and continuous discharge after operation. There were intermittent rises in temperature. Patient was discharged cured.

CASE 10. M. J., male, aged 9, was admitted to the hospital, with empyema. Pus culture showed staphylococci and diplococci. Immediate flap operation was done with ether anæsthesia. The ninth rib was resected. A quart of pus was evacuated at operation. Rubber tissue drain placed under flap. Patient made good recovery.

CASE 11. K. H., female, aged 20 years, was admitted to the hospital with empyema. Culture of the pus showed streptococcus mucosus capsulatus. Immediate flap operation was done under general anæsthesia. The tenth rib was resected. A rubber dam was sutured to the under surface of the flap; no button. Chest drainage stopped at end of second week, temperature rose, and patient had violent attack of coughing followed by profuse discharge. Chest was clear to X-ray and sputum was negative for Bacillus tuberculosis.

CASE 12. C. C. S., male, aged 19, was admitted to hospital, with pneumonia. Three weeks later he had acute abdominal symptoms. Laparotomy showed a ruptured appendix with peritonitis. Three weeks later empyema was demonstrated. A flap operation was done on the right side. The ninth rib was resected. Seventeen days later empyema was found on the left side. A flap operation was done and the tenth rib was resected. Culture from both sides showed pneumococci and staphylococci. Patient developed postoperative psychosis. He was discharged improved. Personal communication reported "cured."

CASE 13. A. R., male, aged 39 years, was admitted to the hospital with symptoms of abdominal pain only; 9 days later empyema diagnosis was established. Flap operation with resection of ninth rib was done. Button was inserted. The flap was lined with rubber dam. Patient made good recovery.



A. B. C.

Fig. 7. The mechanics of the flap. A, Static. B, During inhalation. C, During exhalation.

Case 14. J. G., male, aged 30 years, was admitted to the hospital with dislocation of hip. He had postanæsthetic pneumonia, with lung abscess and a complicating empyema. Flap operation with resection of ninth rib was done. No button was used. He coughed up 1 quart of foul smelling pus. Culture showed staphylococci. He made a good recovery.

Case 15. A. V., male, aged 3 years, was admitted to the hospital, with empyema. Flap operation was done and ninth rib resected; no button. Premature adhesion of flap required loosening. Patient made good recovery (Figs. 14 and 15).

Case 16. M. W., female, aged 22 years, was admitted to hospital in labor. Pneumonia developed 4 days later; protracted sepsis. Six weeks after delivery empyema was discovered. Flap operation with resection of eleventh rib was done. Pus was inaccessible so tenth rib was resected. Localized empyema was reached and drained with a tube sutured beneath the flap. Patient made good recovery. Culture showed gram positive diplococci. Local anæsthesia was used.

Case 17. M. R., female, aged 53 years, had pneumonia followed by signs of fluid in chest. Chest tap gave serofibrinous fluid of negative culture. X-ray showed lung abscess. Surgical consultation was sought 2 months after admission. A flap operation was done under local anæsthesia and ninth rib was resected. Thick, foul smelling pus was obtained. Convalescence was complicated by premature adhesion of flap, which was loosened. Patient made good recovery. Cultures always were negative: tuberculous? (Figs. 10 and 11.)

Case 18. E. S., female, aged 2½ years, was admitted to hospital with empyema. Flap operation was done under ether anæsthesia. The ninth rib was resected. A very thick pleura was found with yeasty smelling pus; no button. Three days after operation X-ray examination showed a collapsed lung. Ten days later the X-ray revealed an expanding lung. Good recovery followed.

Case 19. P. S., female, aged 5, had pneumonia. On thirteenth day a diagnosis of empyema was made. A chest tap gave greenish pus: staphylococci. Flap operation was done under ether anæsthesia. The ninth rib was resected; button inserted. Button was removed on ninth day; good recovery.

Case 20. F. S., male, aged 56 years, had pneumonia. Diagnosis of empyema was made on twelfth day. Chest tap gave thin greenish pus showing cocci, staining characteristics not being described. A flap operation was done under local anæsthesia. The ninth rib was resected; a button was inserted and removed on seventh day. Premature adhesion of flap occurred. The flap was loosened and patient made a good recovery. (Figs. 12 and 13.)

Case 21. E. F., male, aged 45, had pneumonia 1 month previously. He suffered from pain, cough, and foul expectoration for 2 weeks. X-ray examination showed lung abscess of right upper lobe; secondary empyema. Chest tap gave streptococci in pus. Flap operation was done under local anæsthesia. The ninth rib was resected. Twelve ounces of fetid pus was evacuated. Convalescence was complicated by premature adhesion of the flap. The flap was loosened, and patient made a good recovery from empyema. The lung abscess persisted.

Case 22. A. P., male, aged 42. Patient was received from Medical service with diagnosis of postpneumonic empyema; overwhelming infection; other evidences of pyæmia. Chest tap gave thin foul smelling pus. Culture showed a Gram negative bacillus and Bacillus Subtilis. Flap operation was done, the ninth rib being resected; and a button inserted. Pus became thick and creamy on second day after operation; sepsis unchanged. Patient died 30 days after operation.

Case 23. H. S., male, aged 52, had suffered for 3 months with chest symptoms of lung abscess, profound sepsis, and emaciation. X-ray examination showed three fluid levels in the lung: definite abscesses. There was a secondary infection of the pleura with thick greenish pus; flap operation was done and eighth rib was resected. The pleura was thick and adherent to the necrotic lung. There was no odor to the pus which was chocolate colored. Button was inserted and removed on twelfth day. Good recovery followed operation with healing of pleural lesion. Subsequent examinations indicate background of tuberculosis.

Case 24. M. G., male, aged 6½ years. Twenty days before operation, patient had measles; 8 days later, pneumonia. Chest tap gave thick, foul smelling pus which showed pneumococci on culture. A flap operation was done and the eighth rib resected. Button was inserted and removed on fourteenth day. Convalescence was complicated by diphtheria. Patient made good recovery.

Case 25. M. M., male, aged 7, had a right sided pneumonia 1 month before operation. Chest tap previous to operation gave thick greenish pus. The flap operation was

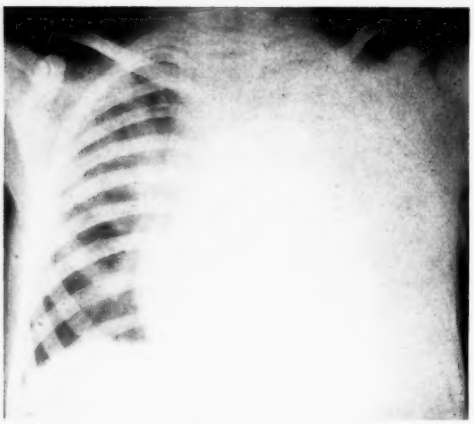


Fig. 8. Case 29 immediately before operation was performed.

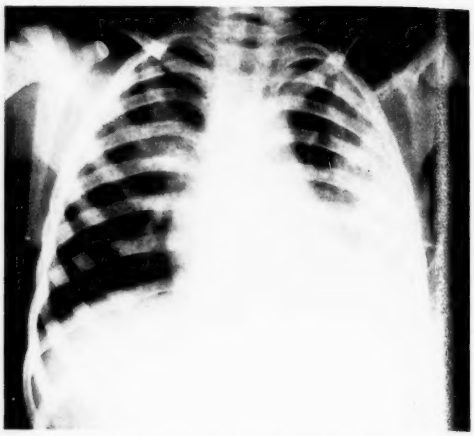


Fig. 9. Case 29, 3 days after operation, showing ing expansion.

done by Dr. Harry J. Handelman. Ether anæsthesia was used. The eighth rib was resected. A button was inserted. Recovery progressed for 23 days then patient had left sided pneumonia. The end-result was good.

Case 26. B. E., male, aged 52, had pneumonia followed by empyema on fifteenth day. Chest tap gave foul smelling pus which showed cultured staphylococci when cultured. Flap operation was done by Dr. Harry J. Handelman, the eighth rib was resected and a button inserted. Patient came to table with concealed massive gastro-intestinal hæmorrhage. This became manifest immediately after operation and continued unchecked. Death was due to uncontrollable gastro-intestinal hæmorrhage. The pleural condition responded correctly to operation.

Case 27. J. L., male, aged 35, had empyema following pneumonia. The condition was discovered 46 days after

Fig. 10. Case 17 immediately before operation was performed.

Fig. 11. Case 17, 6 days after operation, showing l g expansion.

Fig. 12. Case 20 immediately before operation was performed.

Fig. 13. Case 20, 4 days after operation, showing lung expansion.

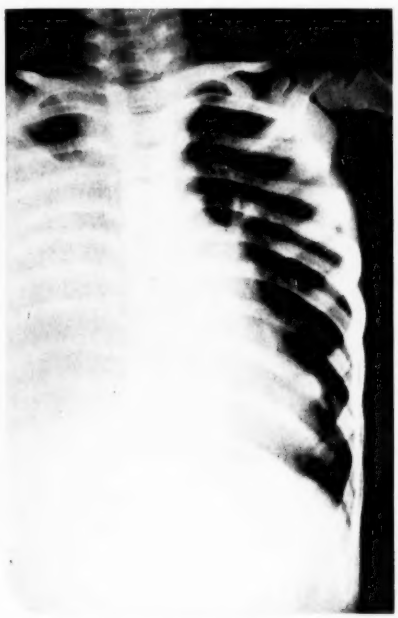


Fig. 14. Case 15 immediately before operation was performed.

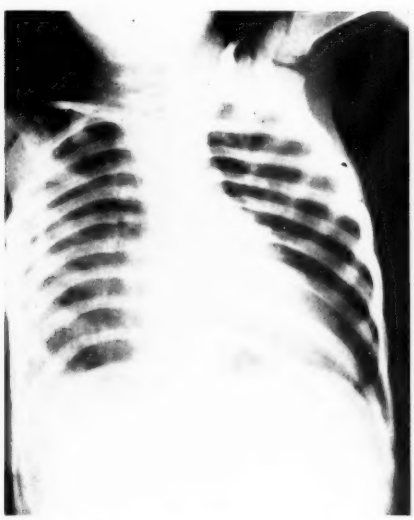


Fig. 15. Case 15, 48 hours after operation, showing lung expansion.

the onset of the pneumonia. Chest tap gave thick pus culturing streptococci and staphylococci. Flap operation was done under local anæsthesia. The ninth rib was resected, a button inserted. Recovery was good.

CASE 28. F. T., male, aged 6. Two years previously patient had pneumonia followed by empyema. Open operation was done then. Patient was admitted to hospital with pneumonia on same side. Twenty-nine days later chest tap gave pus which showed staphylococci on culture. Flap operation was carried out. Pus was found escaping from the pleural cavity between the ribs at site of drainage of previous operation. A button was inserted at this point between the eighth and ninth ribs. No rib was resected. Patient made good recovery.

CASE 29. A. S., male, aged 6, had empyema following pneumonia on eleventh day. Chest tap showed pneumococci. Flap operation was done and eighth rib resected. Button was inserted. The button was removed on fifteenth day. Good recovery followed operation. (Figures 8 and 9.)

CASE 30. E. F., female, aged 13, had empyema following pneumonia. Diagnosis made twenty first day. Chest tap showed pneumococci on culture. Flap operation was done. Good but slow recovery followed, complicated by the necessity for removing inner flange of button which remained behind when removal string broke.

CASE 31. J. R., male, aged 64, had empyema complicating pneumonia, on eleventh day. Chest tap revealed pus showing pneumococci on culture. Flap operation was done under local anæsthesia. The eighth rib was resected and a button inserted. The button was removed on thirteenth day. Good recovery followed.

CASE 32. E. M., female, aged 5, had measles 6 weeks previous to operation; complicated by acute otitis media. Six weeks later empyema was discovered. Chest tap gave culture of pneumococci. Flap operation was done under ether anæsthesia and eighth rib was resected and button inserted. The button was removed on seventh day. Good recovery followed.

CASE 33. H., aged 50, had empyema which was discovered 1 month after pneumonia. Flap operation was done. The chest contained maximum of pus. Button was inserted after resection of eighth rib. The button was removed on sixth day. The wound was entirely healed on the tenth day.

CASE 34. E. R., female, aged 4 months, empyema following pneumonia. Flap operation and resection of eighth rib was done. Button was inserted. Patient made a good recovery. Convalescence was delayed because of complete failure of union of verticals. Flap functioned perfectly, however. Closed drainage persisted throughout, and inspection of the area of rib resection on the fifth day, by elevation of the flap, showed that the pleural lesion was then healed.

CASE 35. W. S., male, aged 28, had postpneumonic empyema. Culture showed streptococci. Flap operation and resection of eighth rib was done. No button was used. Recovery was good although delayed by tendency to premature healing of the flap.

CASE 36. Mrs. McG., female, aged 30, had empyema complicating pneumonia occurring during puerperium. Flap operation and resection of eighth rib with no button resulted in good recovery.

PRIMARY CARCINOMA OF THE URETER

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A REVIEW of the literature on that relatively rare disease, primary carcinoma of the ureter, seemed to indicate that in addition to presenting 2 cases of this character an attempt should be made to determine, in so far as possible, the end-results in all acceptable cases reported heretofore, with the hope that further information might be obtained concerning early diagnosis, proper treatment, and prognosis. By means of correspondence with each writer on this subject, or the clinic from which the case was reported, an effort was made to learn the present status of each case that was reported well following operation. The writer is, indeed, most grateful to all those who obtained and forwarded further information concerning their cases.

Due to the tendency toward more frequent and careful necropsies and the marked progress in the technique of urological diagnosis, primary carcinoma of the ureter has been found with ever increasing frequency during recent years. Wising and Blix reported the first case in 1876. In 1896 Hektoen, in reporting his case, referred to 2 others in the literature. The first correct preoperative diagnosis was reported by Albarran in 1902, and at this time he was able to find 10 acceptable cases in the literature. Richter in 1909 found only 11 cases. In 1916 Schmitt reported 20 cases, and in 1922 Meeker and McCarthy found 33 cases of primary carcinoma of the ureter. Kretschmer in 1929 reported 36 cases including his own. Six years later Rousselot and Lamen were able to find 50 cases including their own. The writer in a review of the literature finds 59 cases of primary carcinoma of the ureter, and in addition presents 2 more.

Because a study of the literature on this subject at once indicates that there is a considerable difference of opinion as to just what constitutes a true case of primary carcinoma of the ureter, it seems advisable to state briefly the conditions met by all cases included in this report. In the first place the gross and microscopic descriptions of the tumor had to justify the diagnosis of carcinoma. Next it was necessary to make certain that there was no possibility of the growth's being secondary to a primary tumor located elsewhere in the genito-urinary tract. Lastly, it was necessary to prove that the ureteral growth could not be due to a metastasis or direct extension from some point outside the genito-urinary tract. It is our belief that the 2 cases to be presented meet these requirements.

CASE 1. C.D., S.M.H., No. 40064, aged 55 years. October 24, 1930. Patient complained of pain in the right side of back. Fourteen months before admission to the hospital the patient noticed a sudden attack of pain in the right kidney region and radiating slightly anteriorly. Morphia was necessary for relief. One month later he had a similar attack, which was accompanied by hæmaturia. He consulted a urologist, who encountered an obstruction of the right ureter which he was unable to pass. An operation was advised but refused. At intervals of a month or two he had recurrent attacks of dull pain in the right kidney region and hæmaturia. The blood in the urine never appeared in the form of worm-shaped clots, but was evenly distributed in all three specimen glasses. There was no history of calculi. The patient had lost 20 pounds in weight during the last year and did not feel so strong as formerly. The family history was unimportant. The past history revealed nothing essential.

The patient was evidently a little anæmic and showed signs of recent loss of weight. The heart was moderately enlarged and the heart sounds were faint. The blood pressure was 130–90. The right kidney was palpable and its surface was smooth. There was a little tenderness in the right upper quadrant. The prostate gland was slightly enlarged.

Laboratory examinations revealed: Blood—white blood cells, 5,920; red blood cells, 5,570,000; hæmoglobin, 78 per cent; Wassermann reaction, negative; non-protein nitrogen, 31 milligrams per 100 cubic centimeters; urine showed albumin +; many red blood cells and an occasional white blood cell; no infection.

Phenolsulphonephthalein test revealed output for first half-hour 47 per cent, second half-hour 22 per cent.

A plain abdominal roentgenogram showed marked enlargement of the right kidney. It was negative for calculi. A uroselectan stereoscopic pyelogram showed a normal kidney on the left side and complete failure to excrete the drug on the right side. X-ray pictures of the thorax, spine, and pelvic bones were negative for metastases.

Cystoscopy was carried out November 3, 1930. Under caudal anæsthesia, 20 cubic centimeters of 3 per cent procain, the bladder and a portion of the prostatic urethra were studied, without discomfort to the patient. There was slight enlargement of the prostate gland. The trigone on the right side seemed to be shortened and there was slight inflammation about the right ureteral orifice which did not present the typical picture of a tuberculous infection. No function was observed on this side. The left ureteral orifice appeared normal and the function seemed to be good. A wax tip bougie was passed about 10 centimeters up the right ureter, where it encountered an impenetrable obstruction. No characteristic stone scratch was obtained. All attempts to pass the point of obstruction met with failure. There was definite bleeding from the right ureteral orifice following the instrumentation, the blood flowing from the orifice in a more or less continuous, copious trickle. An obstruction probably due to a mucosal fold was encountered at about the same level on the left side,

Fig. 1. Specimen removed in two sections which were combined to make a more comprehensive picture. Papillary carcinoma of the middle third of the ureter with a small implant near ureteral orifice.

but was overcome with a little difficulty. A differential kidney function study showed an output of phthalein of 70 per cent in 2 hours on the left side and only a faint trace in the transvesical specimen. An attempt to obtain a right ureterogram was unsuccessful.

At this stage we considered the possibility of primary tumor of the kidney with a secondary ureteral implant, primary tumor of the ureter, and ureteral stricture. The continuous, rather copious flow of blood from the ureter suggested the presence of ureteral tumor.

Operation. Right nephrectomy, November 17, 1930. Under nitrous oxide gas-oxygen ether anæsthesia the kidney was approached through the extraperitoneal route. The patient was a short, thick-set individual, the kidney very large, and it was necessary to resect the twelfth rib in order to obtain a good exposure. The upper portion of the ureter was greatly enlarged and light blue in color, suggesting the presence of blood. The kidney pelvis was also many times larger than normal and of the same color as the ureter. On palpation of the pelvis it seemed as if we were dealing with blood clots within the sac. The kidney parenchyma was thin, as in advanced cases of hydronephrosis. The presence of blood in the ureter and kidney pelvis, in the absence of any findings suggesting a primary tumor of the renal parenchyma, made us at once suspect that we were dealing with a primary tumor of the ureter, or a primary tumor of the kidney pelvis with a secondary involvement of the ureter. The kidney and several centimeters of the ureter were removed, care being observed not to spill any of the contents of the ureter or kidney pelvis in the wound. Two chromic ligatures were placed around the upper end of the remaining portion of the ureter. Because the patient's condition was such that a ureterectomy might be quite dangerous, a cigarette drain was placed to the stump of the ureter and the wound closed. The wound was completely healed and the patient discharged 3 weeks after operation.

At the time of discharge the patient was advised to return in 3 weeks for ureterectomy. One month later he felt so well that he did not desire to have the second operation. However, a few days after this visit he again noticed blood in his urine. On cystoscopy the right ureteral orifice was found to be surrounded for a distance of about 1.5 centimeters by a red, inflamed area, which, while not typical of tumor, was suggestive either of œdema due to a neoplasm of the structures beneath the mucosa or a very early growth in the mucosa.

Operation. Right ureterectomy and resection of portion of bladder wall, January 27, 1931, under spinal anæsthesia. An oblique incision starting low in the abdomen and slightly lateral to the inner border of the rectus muscle was carried to within 3 centimeters of the umbilicus, and from there in a gradually lateral direction to a point about midway between the normal position of the tip of the twelfth rib and the crest of the iliac bone. Then the lower portion of the rectus muscle was separated and the peritoneum was carefully brought to the midline. The dilated lower ureter was easily found. The ureter was then followed toward the point of obstruction and at about the level of the umbilicus it became about 2.5 centimeters in diameter and quite indurated for a distance of 6 centimeters. It was carefully dissected free from surrounding structures until the suture in upper end was freed. Then the ureter was followed to its attachment to the bladder. At this stage the bladder was opened and the inflamed area about the ureteral orifice carefully outlined, and the mucosa and bladder wall within this area were removed with the ureter. The opening in the bladder wall was closed with chromic sutures placed externally. The mucosal surface was closed with plain catgut sutures. The vesical orifice was cut and a suprapubic tube placed in the bladder for drainage. A small drainage tube was placed external to the bladder at the former site of the ureteral orifice. The wound was closed, the patient leaving the table in good condition. He was apparently in excellent condition when discharged from the hospital 3 weeks after this operation.

Gross pathology. The kidney is greatly enlarged. The pelvis and ureter are dilated and filled with a blood stained

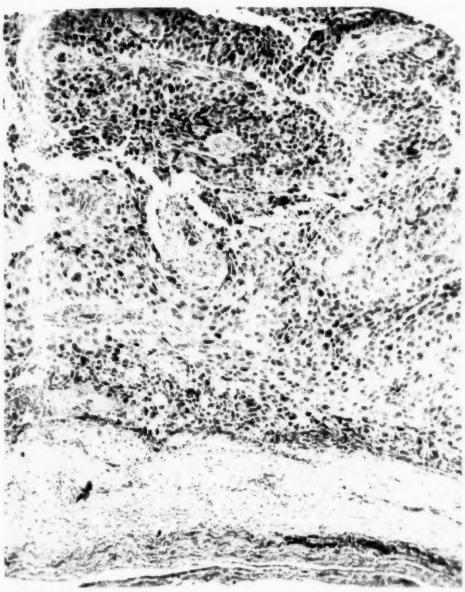

Fig. 2. Low power microscopic view showing ureteral wall and transitional cell papillary carcinoma attached to it.

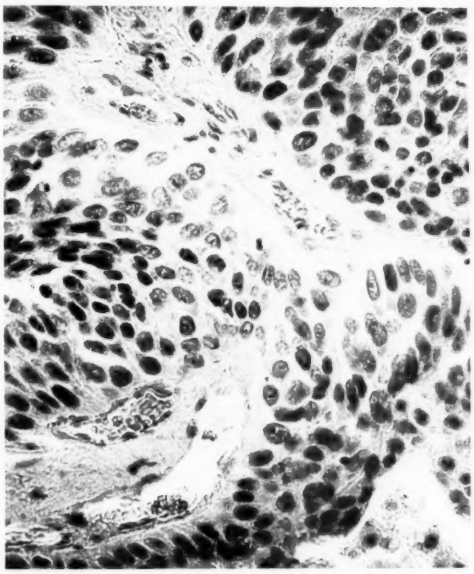

Fig. 3. Higher magnification of the same tumor, showing marked variation in size, shape, and staining characteristics of cells.

fluid in which there are a few small clots of blood. The calyces are greatly dilated and the cortex thin. The mucosal surface is inflamed, suggesting an infectious process. The ureter is dilated. No tumor is present in the renal parenchyma, the pelvis, and the portion of the ureter removed (Fig. 1).

Attached to the lower end of the ureter is a circular portion of bladder 2 centimeters in diameter. Just on the edge of the orifice is a small tumor implant. The mucosa about the orifice is inflamed and œdematous. The lower third of the ureter is dilated. The wall is thickened and the mucosa inflamed. The upper portion of the middle third of the ureter is filled with an indurated mass and is about 2.5 centimeters in diameter and 6 centimeters in length. Above the tumor mass there is about 3 centimeters of ureter which in all respects resembled the lower third (Fig. 1).

Microscopic pathology. Histological specimens from the kidney were negative for tumor. The picture presented was typical of an advanced hydronephrosis plus moderate infection.

Histological report of specimen of ureter by Dr. W. B. Hawkins: Histological sections from the ureter show a papillary transitional cell carcinoma similar in type to that found frequently in the bladder. Along the ureter one finds masses of transitional cells lying beneath the mucosa, some of which show central degeneration. The picture is not unlike that seen in cystitis cystica. The cells forming these masses become more anaplastic as one approaches the main tumor. Portions of the tumor are formed of large masses of cells with a central core of fibrous tissue and vessels. These represent papillæ which have been cut across. In other areas there are long papillary projections of fibrous tissue carrying blood vessels, and these are covered by epithelium, the number of layers of which vary considerably. The stroma is formed of delicate fibrous tissue and it appears œdematous. The muscularis of the ureter shows no evidence of invasion (Fig. 2). There is some round cell infiltration of the mucosa. Some polymorphonuclear cells are seen in the tumor, which is necrotic in portions. The individual tumor cells are of interest because of the varying size and shape. Mitotic figures are very numerous and all stages of division appear to be present. Some nuclei appear hyperchromatic, while others are pale and vesicular. Tumor giant cells are plentiful and show pink-staining cytoplasm with large hyperchromatic nuclei or multiple nuclei (Fig. 3).

CASE 2.[1] W.P., S.M.H., No. 57678, aged 36 years. February 16, 1932. Patient complained of pain in right thigh and foot, recurrent hæmaturia, and pain in abdomen. In the Spring of 1930 the patient experienced drawing sensations and pain in the right calf and thigh. Several months later he first noticed pain in the right kidney region. In the Spring of 1931 he observed blood in his urine and a burning sensation with urination. During the summer the pain in his back became quite intense, and although he was under the care of a physician he obtained no relief. In June, 1931, his right side and leg were bruised in an automobile accident, resulting in slight immediate discomfort. However, a few days later the pain in right kidney region became more intense and constant and began to radiate down the course of the right ureter to the groin. Two days after the accident the patient had gross hæmaturia on two occasions. One month after the accident a urologist was

[1]The writer is deeply indebted to Dr. David Melen and Dr. Harry D. Clough, of the Rochester General Hospital, for the detailed report of the patient's course while in that institution. He also wishes to thank Dr. Harry Fortner and Dr. W. B. Hawkins, of the Pathological Department of the University of Rochester School of Medicine and Dentistry, for their valuable assistance in the preparation and interpretation of the pathological studies presented.

Fig. 4. Autopsy specimen showing papillary carcinoma of middle and lower third of right ureter.

consulted, who found a mass in the right kidney region and obstruction of the right ureter, with complete loss of function of the kidney. A right nephrectomy was performed in November, 1931, by Dr. David Melen, of the Rochester General Hospital, who found a markedly dilated kidney, the pelvis of which was many times larger than normal and filled with blood clots. The upper end of the ureter was also explored, and no tumor found. The specimen removed was carefully studied by Dr. Istvan Gaspar, pathologist of the hospital, who found no tumor and made a gross and microscopic diagnosis of hydronephrotic atrophy of the right kidney. The patient had an uneventful convalescence from his nephrectomy and felt much improved when discharged from the hospital, December 5, 1931. However, it was not long before his appetite became poor, constipation became troublesome, and finally vomiting occurred. At this time blood appeared in his stools. On February 16, 1932, he visited the out-patient department of the Strong Memorial Hospital, complaining more specifically of pain in the right thigh, leg, and ankle than of other symptoms mentioned above. It was found that he had atrophy of right buttock, thigh, and calf, beginning atrophy of right ankle, and obliteration of talus and calcaneum joint. There was no palpable abdominal mass, but there was a small bleb in the upper end of the nephrectomy wound. He was advised to enter the hospital for further study, but refused. Ten days later he came to the emergency department complaining of pain and mass in the epigastric region. Six days before he had suddenly experienced a sharp pain in the epigastric region, and on palpation felt a mass. This pain was almost continuous and was complicated by nausea and vomiting. Eating intensified his pain. He was taking mineral oil to insure daily bowel movement. The stools were brown and well formed. He also had pain in the right kidney region and radiating down to groin and right thigh.

The family history was unimportant. The past history was negative except for an ankylosis of the right ankle due to osteomyelitis 20 years before admission.

The patient showed evidence of recent loss of weight. His temperature was 37.5 degrees C. and his pulse 130. There was a draining sinus at the upper end of his nephrectomy wound. A firm, fairly hard mass, with slightly rounded edges, was felt in midline about 2 centimeters above the umbilicus and extending up to the xiphoid process. The mass, which moved with respiratory movements and could be displaced slightly in each lateral direction, extended about 4 centimeters to either side of the midline. Muscle spasm and tenderness over the region occupied by the mass were absent. Other positive physical findings are not considered essential in this case.

Laboratory examinations revealed the following:

Blood—white blood cells, 22,000; hæmoglobin, 65 per cent. The urine was negative for sugar and albumin. There were a few pus cells but no red blood cells.

Abdominal roentgenogram was negative.

It was thought that the patient had either a walled-off abscess of the abdomen or a carcinoma of the stomach or transverse colon.

Operation. An exploratory operation was carried out and it was found that the mass in the abdomen was due to the rupture of a carcinomatous growth of the transverse colon with an early abscess formation. The abscess was drained and a colostomy performed. The patient ran a downhill course, dying on the second day after operation.

Autopsy findings. It was found that the patient had an undifferentiated type of carcinoma of the transverse colon with metastases to the mesentery glands. There was a small draining sinus to the region formerly occupied by the kidney. The upper end of the ureter was free from tumor, but the middle and lower ends were filled with a papillary growth that invaded the ureteral mucosa in many places. There was a small papillary growth extending through the right ureteral orifice. The ureter was surrounded by a mass of very adherent fatty tissue in the involved regions. Metastases were found in the retroperitoneal lymph glands, in the region of the renal vessels in the right side, and in the vena cava (Fig. 4).

Histological report was made by Dr. W. B. Hawkins: Histological section reveals an enlarged ureter with a large lumen, which is completely filled by a papillary transitional cell carcinoma. The papillary projections are long and formed mostly of layers of epithelial cells with a central core of fibrous tissue in which the vessels course. The tumor is sharply demarcated, with no infiltration into the wall, but there are large spaces in the muscularis which are completely filled by tumor cells (Fig. 5). The centers of some of these solid masses have undergone necrosis, and there is calcium deposition in one area of dead tissue. The tumor cells are not markedly anaplastic, but mitotic figures are present (Fig. 6).

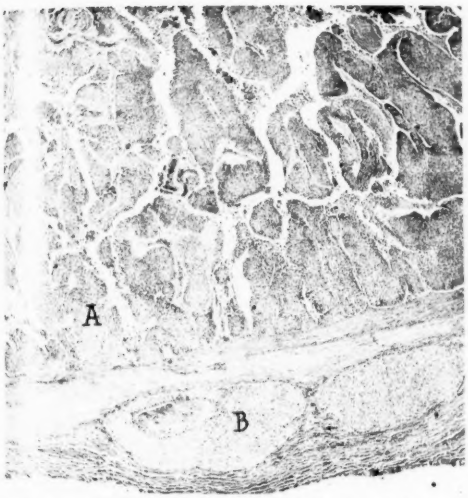

Fig. 5. *A*, Papillary carcinoma of the lumen of the lower ureter. *B*, Involvement of muscularis with a mass of tumor cells.

The small thrombus mass in the vena cava proves to be formed of tumor, and the connective tissue about the vein is infiltrated by masses and strands of transitional epithelial cells. The retroperitoneal connective tissue also shows invasion by tumor with lymphatic channels occluded. There is considerable necrosis with some calcium deposition (Fig. 7).

PATHOLOGY

In the absence of a uniform type of nomenclature it is, indeed, very difficult to present an accurate histological classification. Although a review of the gross and microscopic descriptions of the tumors classified as medullary carcinomata, cylindrical cell carcinomata, etc., suggests that some of these might have originated as papillary growths, it seemed advisable from the standpoint of accurate reporting to retain the original diagnosis. The various types of tumors and their frequency of occurrence are shown in Table I.

Metastases were demonstrated in 23 of the cases, while in 8 others nearby structures were involved by direct extension. The relative frequency of involvement of the following organs by metastases was: retroperitoneal lymph glands, 17; liver, 9; lungs, 8; pancreas, 2; bladder, 2; opposite kidney, 2; and once each in the adrenal, spleen, pericardium, pleura, pelvis, vertebral column, and skin. It would seem that metastasis from primary carcinoma of the ureter occurs earlier and more frequently than from carcinoma of the bladder.

TABLE I.—VARIOUS TYPES OF TUMOR IN THIS SERIES, 61 CASES

Type of growth	No.
Papillary carcinoma	36
Squamous cell carcinoma	9
Medullary carcinoma	7
Solid carcinoma	3
Carcinoma simplex	3
Adenocarcinoma	1
Cylindrical cell carcinoma	1
Transitional cell carcinoma	1
Total	61

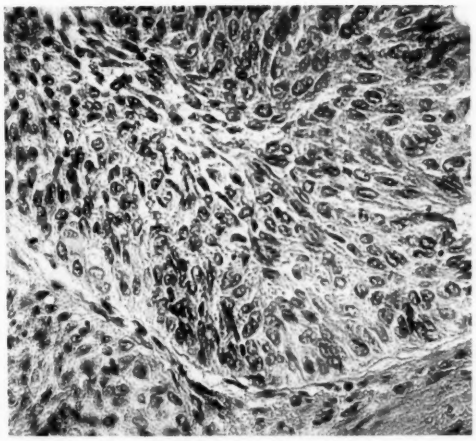

Fig. 6. Higher magnification of an area from Figure 5, showing typical transitional cell papillary carcinoma.

LOCATION OF GROWTH

The site of the primary tumors in this series is shown in Table II.

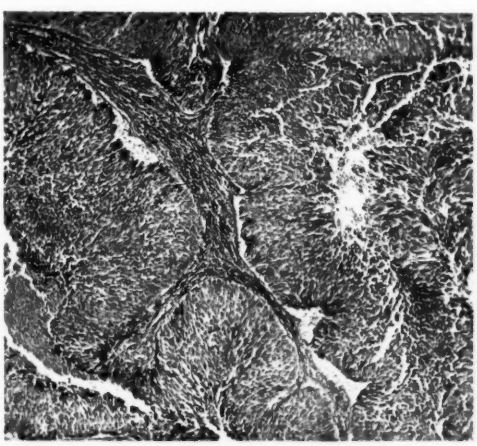

Fig. 7. Characteristic transitional cell papillary carcinoma structure found in thrombus mass in vena cava.

TABLE II.—SITE OF GROWTH, 61 CASES

Portion of ureter involved	Right ureter	Left ureter	Total
Upper third	5	6	11
Middle third	6	3	9
Lower third	18	17	35
Middle and lower third	3	1	4
Upper and lower third	1		1
Whole ureter	1		1
Total	34	27	61

In a small series of cases such as this the fact that the right ureter is involved a little more frequently than the left is probably of no significance. However, it is interesting to speculate as to the reason for the involvement of the lower third of the ureter in 57 per cent of the cases. One wonders if it is for the same reason that bladder tumors are found more frequently in the region of the ureteral orifice and trigone.

AGE OF PATIENTS

In 60 cases the patient's age was given. The youngest patient, who was reported by Albarran, was 33 years of age and had a papillary carcinoma. The oldest patient in this series was a man of 89 years, who had carcinoma of the left ureter.

The average of the patients' ages in this series was 55.7 years. It is interesting to note that the disease occurred with equal frequency in the fifth, sixth, and seventh decades of life.

THE DIAGNOSIS OF PRIMARY CARCINOMA OF THE URETER

Symptoms. Although it is true that the most common symptoms of primary carcinoma of the ureter are not characteristic of this disease alone, nevertheless their presence may prove to be the deciding factor in arriving at a correct diagnosis where the information derived from further studies is not quite conclusive.

Hæmaturia, either gross or microscopic, is the most common symptom of this disease, occurring in 72 per cent of the cases. It usually appears relatively early in the disease, especially in those patients having papillary carcinomata. At first the gross bleeding is of short duration, but as the growth develops the bleeding not only increases in amount but occurs more frequently. In cases of carcinoma of the lower portion of the ureter in women it is sometimes possible to start bleeding by means of vaginal palpation.

Pain is the next most common symptom, occurring in 65 per cent of the cases. In an effort to determine if there existed any relation between

TABLE III.—AGE OF OCCURRENCE, 60 CASES

Age of patient	No.
30–39	7
40–49	15
50–59	15
60–69	14
70–79	7
80–90	2
Total	60

the location of the tumor and the character and location of the pain resulting from it the cases in this series were divided into tumors of the upper, middle, and lower ureter, and each group studied separately. The only observation arising from this approach was that frequency of urination was noticed more often in those patients having tumors of the lower and middle portions of the ureter. In the cases that were somewhat more advanced the pain in the kidney region became more constant and frequently less intense, and in a number of instances seemed to be due to the presence of a large hydronephrotic kidney. In those cases in which the pain is referred to the lumbar and sacral regions, the thigh, hip-joint, leg, and arm, the disease is in an advanced stage and the prognosis is usually bad. In a group of 20 cases having pain in these regions not 1 patient lived more than 8 months.

Tumor. In 40 per cent of the cases a palpable mass was present. In most instances this proved to be a dilated kidney. However, there were a few cases in which the primary growth was palpable on either abdominal, vaginal, or rectal examination.

Among the other symptoms that were less commonly observed were loss of weight, dysuria, tenderness, nausea, vomiting, right varicocele, and chills and fever in some of the infected cases.

Other diagnostic aids. A thorough microscopic examination of the urine is essential. In one case in this series cancer cells were found in the urine, while in another detached papillomatous villi were present.

While it is seldom that X-ray examinations yield conclusive proof of a primary carcinoma of the ureter, the findings are sometimes quite suggestive and tend to support the accumulative evidence in favor of such a diagnosis. In advanced cases metastases to bony structures may be observed in the plain X-ray plate. A negative plate for stone, plus the absence of a characteristic scratch on the wax tip bulb following ureteral manipulation, practically eliminates the possibility of calculus. In those cases in which ureteral calculus and traumatic stricture have been ruled out a pyelogram, obtained by either the retrograde or intravenous method, showing a partial

obstructed ureter with dilatation above the point of obstruction and an enlarged kidney pelvis with no filling defects of the type seen in primary carcinoma of the renal pelvis or parenchyma, suggests the possibility of primary carcinoma of the ureter, especially if there has been a story of recurrent hæmaturia and on cystoscopic examination blood flows copiously from the involved side in a more or less steady stream following the ureteral manipulation. The retrograde pyelograms have not been sufficiently characteristic to enable one to make a diagnosis by this means alone. With but one exception marked distortion of the ureter has been observed. The value of intravenous pyelography in this disease has not as yet been determined.

Most valuable information is frequently obtained by cystoscopic examination. In 8 cases the diagnosis was made from the observation of tumor protruding through the ureteral orifice, while in another a small implant close to the ureteral orifice suggested that the ureteral obstruction on that side was due to the presence of a primary tumor. Except in those rare cases where calculus is found as a complicating factor in primary carcinoma of the ureter, a negative X-ray plate for stone and the absence of a typical scratch on the wax tip bulb following ureteral manipulation practically rule out calculus. Persistent, rather copious, steady bleeding from the orifice on the involved side following ureteral manipulation with a catheter, especially in those cases where there is no history suggesting stricture due to trauma or infection, is quite suggestive of carcinoma of the ureter. Bleeding of this same character has been observed following abdominal and vaginal manipulation over the site of the growth. In one case the diagnosis was made from sections of tissue removed from the ureter by means of ureteral forceps. In a very few cases of carcinoma low down in the ureter the orifice was surrounded by a bulging, circumscribed area, the mucosa of which was œdematous and congested, probably due to malignant infiltration of the structures beneath.

In primary carcinoma of the lower and middle portions of the ureter a dilated, blood filled ureter and renal pelvis was a very common finding in those cases in which the operator elected to approach the problem by means of a nephrectomy with removal of the upper portion of the ureter, or a nephro-ureterectomy. The absence of tumor in the kidney pelvis and the portion of ureter removed, in the presence of these findings, is another link in the chain of evidence supporting a diagnosis of primary carcinoma of the middle or lower ureter in cases where a positive preoperative diagnosis cannot be made.

TREATMENT

Forty-five of the patients studied in this series were operated upon. Seventeen were given palliative treatment only, the diagnosis being positively made at autopsy. In a few instances deep X-ray and radium therapy were tried, but found to be of questionable value. In 1 of the writer's cases deep X-ray therapy seemed to ease the pain in back for a while, but failed to stop the process of metastasis.

In order that a more comprehensive understanding of the problem presented by each operative case may be obtained, a brief summary of each one is presented here (Table IV).

Types of operation. The absence of a preoperative diagnosis, or the presence of a wrong one, no doubt accounts for the great variety of operative procedures found in Table V.

It is quite evident that many of these operations were only performed as a palliative measure.

POSTOPERATIVE MORTALITY

In this group have been included all cases in which the patient did not sufficiently recover from the operation to leave the hospital in a reasonable period of time. There were 12 such cases, making a postoperative mortality of 27 per cent. In 2 cases in which the patients had an advanced stage of the disease death occurred 31 and 39 days after simple exploratory operation. Another patient died of peritonitis following a colostomy for ruptured carcinoma of the transverse colon. There were 3 deaths following 9 nephro-ureterectomies. One patient died shortly after operation of paralytic ileus; another on the second day, of delayed shock; and a third died of ûræmia 1 month after operation. There were 3 deaths in a group of 9 patients who had a nephrectomy with partial resection of the ureter. One death occurred 8 hours after operation from embolus; another on the third day, from myocardial failure; and a third 9 days after operation, the cause not being clearly determined. One patient having a nephrectomy and splenectomy died 25 hours later from shock. Another patient died of delayed shock 2 days after a nephrectomy. Death from shock occurred in another case a few hours after a nephrotomy.

The high postoperative mortality in this series would seem to indicate that the character of the disease plus the relatively advanced age of the patient in the average case results in a markedly lowered resistance to operative shock. Even the

TABLE IV.—SUMMARY OF 44 OPERATIVE CASES

Reported by	Age, sex	Location and duration of symptoms	Pathology	Operation	Result
Rousselot and Lamen	48 F	Upper third of left ureter. 6 wks.	Gross: large indurated tumor mass of upper third of ureter, extending to ureteropelvic junction: pyonephrosis: renal calculi. Microscopic: squamous cell carcinoma. Metastases to regional perigastric and peribronchial lymph nodes, adrenals, pancreas, liver, lungs, and pleura	Exploratory laparotomy with drainage of dermoid cyst of left ovary	Died 31 days after operation
D'Aunoy and Zoeller	59 F	Lower third of right ureter. 1 wk.	Gross: papillary growth in lower third of right ureter. Microscopic: papillary carcinoma	1. Ureterectomy 2. Nephrectomy, 40 days later	Well 2 yrs. after operation. (Personal communication with Dr. D'Aunoy)
Ockerblad and Helwig	75 F	Middle third of left ureter. 9 mos.	Gross: large indurated mass in middle third of left ureter, extending to ileum, duodenum, surrounding vena cava, and attached to psoas muscle. Microscopic: papillary carcinoma of left ureter. Metastases to liver	Drainage of pus from mass	Died 3 mos. later. Deep X-ray without effect
Kretschmer	74 M	Upper third of right ureter. 5 wks.	Gross: indurated mass involving upper third of ureter, extending almost to ureteropelvic junction. Microscopic: papillary carcinoma	Nephro-ureterectomy	Died 15 mos. later. Mass in flank. (Personal communication with Dr. Kretschmer)
Kneise	57 M	Lower third of ureter. 18 mos.	Gross: tumor mass involving lower third of ureter and sticking out through orifice into bladder. Microscopic: papillary carcinoma	Resection of lower 8 cm. of ureter and portion of bladder. Upper end of ureter lost before it could be transplanted to bladder. Wound healed. Kidney above probably dead	Died 1 yr. later. Metastases to liver. (Personal communication with Dr. Kneise)
Dzialoszynski	65 F	Lower third of right ureter. 8 mos.	Gross: papillary tumor involving lower third of right ureter and extending from ureteral orifice. Microscopic: papillary carcinoma	Nephrectomy. Ureterectomy 6 wks. later	Well 3 yrs. after operation. Unable to follow further. (Personal communication with Dr. Dzialoszynski)
Dzialoszynski, reported by Hoebler	69 M	Lower third of left ureter. Duration not given	Gross: hard, indurated mass in left ureter, involving lower third. Microscopic: papillary carcinoma	Nephro-ureterectomy	Died following operation. Paralytic ileus: intestinal infarct
Vorpahl	60 F	Lower right ureter. 1 yr.	Gross: carcinomatous mass arising in lower part of right ureter: hydro-ureter: hydronephrosis. Microscopic: medullary carcinoma. Metastases: retroperitoneal lymph nodes, liver, lungs	Nephrectomy. Partial resection of ureter	Death 8 hrs. after operation. Symptoms of embolus
Grueneberg	40 M	Upper third of right ureter. 7 mos.	Gross: tumor of right ureter 3.5 cm. below pelvis and extending 3 cm., and about 1 cm. in circumference. Microscopic: carcinoma simplex	Nephrectomy with resection of 9 cm. of ureter	Died 2 yrs. later. Metastases to retroperitoneal glands, uterus. Swelling of leg and scrotum. (Personal communication with Dr. Grueneberg)
Lowenstein	56 F	Lower third of left ureter. 10 yrs.	Gross: indurated mass involving lower half of left ureter. Microscopic: papillary carcinoma	Nephrectomy. Splenectomy	Died 25 hrs. after operation: shock
Walker	38 not given	Right ureter. 6 yrs.	Gross: tumor mass involving the whole of right ureter. Microscopic: papillary carcinoma	Nephrectomy. Ureterectomy 2 mos. later	Died few mos. after operation. Metastases to liver, skin, and pelvis
Albarran	33 M	Two tumors, upper and lower third of right ureter. 4 yrs.	Gross: two well localized tumor masses, one in upper and one in lower third of right ureter. Microscopic: papillary carcinoma	Ureterectomy and nephrectomy 2 mos. later	Well 3 mos. after operation. Patient believed to have died, but not certain. (Personal communication with Dr. Lecaul)
McCown	45 M	Upper third of left ureter. Duration not given	Gross: papillary tumor growth involving upper third of left ureter. Microscopic: papillary carcinoma	Nephrectomy with resection of upper portion of ureter	Death 3 days after operation: myocardial failure
Player	65 F	Upper third of left ureter. 2 yrs.	Gross: carcinomatous mass in upper third of left ureter. Microscopic: papillary carcinoma	Nephrectomy with resection of upper third of ureter	Died of metastases 2 yrs. later

TABLE IV.—SUMMARY OF 44 OPERATIVE CASES—Continued

Reported by	Age, sex	Location and duration of symptoms	Pathology	Operation	Result
Volante	49 M	Lower left ureter. 3 yrs.	Gross: carcinomatous mass involving lower left ureter and extending to colon, peritoneum, spinal column, and muscles. Calculus above mass. Metastases to lymph glands and lungs. Microscopic: papillary carcinoma	Exploratory, with drainage of pus sac in lower left quadrant	Died 11 mos. later
Judd, Parker, and Morse	54 M	Lower right ureter. 5 mos.	Gross: tumor mass in lower portion of right ureter. Microscopic: papillary epithelioma	Prostatectomy, nephrectomy, ureterectomy	Died 6 mos. after last operation. Cause not given. (Personal communication with Dr. Judd)
Metcalf and Safford	47 M	Lower left ureter. Several yrs.	Gross: carcinomatous mass involving lower half of left ureter, and calculus. Microscopic: adenocarcinoma	Nephrectomy and resection of upper portion of ureter. 3 mos. later partial removal of remaining ureter	Died of metastases 10 wks. after last operation. (Personal communication with Dr. Safford)
Blatt	55 M	Lower right ureter. 15 mos.	Gross: indurated mass in right ureter. Microscopic: medullary carcinoma of right ureter	Nephrectomy followed by ureterectomy	Died 7 mos. later
Van Cappelen	46 F	Middle of right ureter. 12 mos.	Gross: mass in middle portion of right ureter. Microscopic: papillary carcinoma	Nephrectomy. Ureterectomy 5 mos. later	Well 4 wks. after operation. (Further information not obtainable)
Finsterer	35 M	Lower third of left ureter. 4 yrs.	Gross: papillary tumor involving lower third of left ureter. Microscopic: papillary carcinoma	Resection of lower fourth of ureter and portion of bladder about orifice: transplantation of ureter to bladder	Recovered from operation. Was soldier operated upon during the war, and therefore lost track of. (Personal communication with Dr. Finsterer)
Nilssen	68 F	Lower right ureter. 2 mos.	Gross: tumor mass involving lower right ureter. Hæmatonephrosis. Metastases to retroperitoneal lymph glands. Microscopic: papillary carcinoma	Nephro-ureterectomy	Died of uræmia 1 mo. later
Mraz	69 F	Lower right ureter. 5 mos.	Gross: fusiform enlargement just above bladder. Thickened mucosa extending around ureter. Microscopic: annular carcinoma of ureter	Uretero-nephrectomy	Died of general carcinomatosis 8 mos. later
Papin	58 M	Upper right ureter. 2 mos.	Gross: carcinomatous mass filling upper 4 cm. of right ureter. Microscopic: cylindrical cell epithelioma	Resection of carcinomatous portion of ureter, with transplantation of remaining ureter to kidney pelvis	Well 20 days after operation. (Further information could not be obtained)
Day, Fairchild, and Martin	40 F	Lower right ureter. 6 mos.	Gross: tumor mass in right ureter. Microscopic: papillary carcinoma	Nephrectomy and partial ureterectomy	Died of metastases 1 yr. later. (Personal communication with Dr. Day)
Stewart	76 F	Middle right ureter. 8 mos.	Gross: papillary tumor mass of middle of right ureter. Microscopic: papillary carcinoma	Nephrectomy and partial ureterectomy	Died 4 yrs. later, aged 80, of pneumonia and cardiac failure. No urinary symptoms or symptoms suggesting metastases. (Personal communication with Dr. Stewart)
Gottlieb	49 F	Middle third of left ureter. 18 mos.	Gross: carcinomatous mass in middle third of left ureter, extending to retroperitoneal glands. Microscopic: medullary carcinoma of ureter	Nephrectomy and resection of upper portion of ureter	Recovery after operation. Further information could not be obtained. Presence of retroperitoneal glands at operation would make prognosis bad
Suter	65 M	Lower left ureter. 10 mos.	Gross: papillary mass in left ureter in region of iliac vessels. Microscopic sections not made, but from description probably papillary carcinoma	Nephrectomy and partial removal of ureter	Died 9 days after operation

TABLE IV.—SUMMARY OF 44 OPERATIVE CASES—Continued

Reported by	Age, sex	Location and duration of symptoms	Pathology	Operation	Result
Hunt	61 M	Lower right ureter. 1 yr.	Gross: papillary tumor in lower portion of right ureter. Microscopic: papillary epithelioma	Nephro-ureterectomy	Well 1 yr. later. Further information could not be obtained. (Personal communication with Drs. Hunt and Judd)
Chevassu	53 M	Upper third of left ureter. 1 yr.	Gross: two nodular tumors of upper third of left ureter. Microscopic: epithelioma	Nephro-ureterectomy	Died 3 yrs. later, of metastases to pelvis. (Personal communication with Dr. Chevassu)
Butler	53 M	Middle right ureter. 19 mos.	Gross: hard, carcinomatous mass in central portion of right ureter, extending to psoas muscle, peritoneum, and lumbar plexus. Microscopic: squamous cell carcinoma	Exploratory	Died 30 days after operation
Zironi	36 F	Middle of right ureter. 1 yr.	Gross: indurated, carcinomatous mass in middle portion of right ureter: hydro-ureter and hæmatonephrosis. Microscopic: squamous cell carcinoma. Metastases to retroperitoneal glands	Nephrotomy	Died following operation
Davy	53 M	Lower left ureter. 3 yrs.	Gross: tumor mass in lower portion of left ureter, invading bladder and rectum. Metastases to lumbar nodes and liver. Calculus at site of mass. Microscopic: encephaloid carcinoma	1. Nephrotomy 2. Nephrectomy	Died 2 mos. later of metastases
Crance and Knickerbocker	43 F	Lower right ureter. 1 yr.	Gross: tumor mass of lower right ureter. Microscopic: epithelioma	Uretero-nephrectomy	Well 8 yrs. later. (Personal communication with Dr. Crance)
Aschner	38 M	Upper right ureter. 3 wks.	Gross: indurated mass in upper portion of right ureter: leucoplakia of renal pelvis: renal calculus. Microscopic: squamous cell carcinoma	Nephrotomy Nephre-ureterectomy	Died 7 mos. later: uræmia
Paschkis and Pleschner	55 F	Lower right ureter. 2 yrs.	Gross: small tumor about 1.5 cm. in length, starting about 1 cm. above right ureteral orifice. Microscopic: papillary carcinoma	Nephro-ureterectomy	Recovered, but was lost track of. (Personal communication with Dr. Paschkis)
Judd and Struthers	48 M	Lower left ureter. 2 yrs.	Gross: tumor mass in lower left ureter. Microscopic: papillary epithelioma	Nephrectomy. Ureterectomy, with resection of portion of lower bladder wall, 11 days later	Died 2 yrs. later: cause not stated. (Personal communication with Dr. Judd)
Hofmann	35 M	Lower left ureter. 4 yrs.	Gross: tumor mass in lower left ureter. Microscopic: papillary carcinoma	Resection of ureteral orifice and lower 10 cm. of ureter: transplantation of ureter to bladder	Lost track of. (Personal communication with Dr. Hofmann)
Posner	66 F	Middle and lower right ureter. 8 mos.	Gross: papillary tumor in lower two-thirds of right ureter and a portion extending from orifice. Microscopic: papillary carcinoma	1. Nephrectomy and partial ureterectomy. 2. Ureterectomy and resection of portion of bladder wall 41 days later	Recovery. Further information could not be obtained
Israel	60 F	Lower left ureter. 10 yrs.	Gross: papillary tumor involving lower left ureter. Microscopic: papillary carcinoma. Metastases to right kidney	Exploratory and nephrectomy	Postoperative death
Scheele	61 F	Lower left ureter. 6 mos.	Gross: indurated carcinomatous mass in lower left ureter, involving adjacent tissues, and in region of iliac vessels. Microscopic: solid, richly cellular carcinoma	Nephro-ureterectomy	Died 2 days after operation
Chiari	54 F	Middle left ureter. 3 mos.	Gross: tumor involving middle of left ureter, base broad and extending through to surrounding tissues. Microscopic: papillary carcinoma	Nephro-ureterectomy	Well 1 yr. later. Unable to follow further. (Personal communication with Dr. Chiari)
Kraft	52 F	Middle and lower left ureter. 5 mos.	Gross: two papillary tumors, one in middle and one in lower portion of left ureter. Microscopic: papillary epithelioma	Nephro-ureterectomy	Well July, 1912 (11 yrs.) (Personal communication with Dr. Kraft)

TABLE IV.—SUMMARY OF 44 OPERATIVE CASES—Continued

Reported by	Age, sex	Location and duration of symptoms	Pathology	Operation	Result
Scott (Case 1)	55 M	Middle of right ureter. 1 yr.	Gross: carcinomatous mass involving about 6 cm. of middle portion of right ureter, indurated, and contained within ureteral wall: small metastatic nodule in ureteral orifice. Metastases to retroperitoneal glands and liver. Microscopic: papillary carcinoma	Nephrectomy and partial resection of ureter. Ureterectomy with resection of portion of bladder wall 2½ mos. later	Condition fine for about 5 mos. Then developed pain in right side and began to lose ground. Died of carcinomatosis 11 mos. after 2d operation
Scott (Case 2)	36 M	Middle and lower right ureter. 18 mos.	Gross: papillary tumor filling entire middle and lower portions of right ureter, with a small portion sticking through the ureteral orifice. Metastases to retroperitoneal lymph nodes and region of renal vessels. Entirely different type of carcinomatous growth in transverse colon. Microscopic: papillary carcinoma	Nephrectomy. Four mos. later exploratory and colostomy for intestinal obstruction	Died 2 days after 2d operation: shock, peritonitis

most skillful removal of a large hydronephrotic kidney of long standing is sometimes followed by a degree of shock apparently greatly in excess of the trauma to the patient. Because this disease by its very nature lends itself to a two or even three stage operation, if necessary, it would seem that close observation of the patient, plus a willingness on the part of the operator to stop before the patient is dangerously shocked, would tend to decrease considerably the postoperative mortality. A ureterectomy plus a permanent nephrostomy, rather than a nephrectomy, may be indicated where the opposite kidney is subnormal.

REMOTE DEATHS IN FOLLOWED CASES

In 13 cases death from cancer due to metastases, recurrence of growth, or the presence of the primary tumor, followed operative treatment. Death from metastases followed nephro-ureterectomy, uretero-nephrectomy, nephrectomy with partial removal of the ureter, nephrectomy followed by ureterectomy, etc. In 9 cases it was thought at operation that all the local growth was completely removed. Nine patients died within 1 year; 1, 15 months after operation; 2 died of metastases 2 years, and 1, 3 years after operation.

The cause of death was either not known or attributed to some other disease in 5 cases of this series. One patient died of uræmia 7 months after operation. Another died at 80 years of age of pneumonia and cardiac failure, 4 years after a nephrectomy and partial ureterectomy for papillary carcinoma of the middle portion of the ureter. At the time of her death there was nothing to suggest that she had metastases or a recurrence of the primary growth, and it can be assumed that the disease was at least arrested, if not cured.

CASES NOT FOLLOWED

There were 11 cases in which the follow-up information was not complete. In 4 instances the questionnaires were not answered, and in the remaining cases the writers reported that all attempts to obtain further information were unsuccessful. Seven patients were not followed after their discharge from the hospital; 1 was followed 3 months; 2, 12 months; and another 3 years. In view of the fact that of those patients followed after operation more than 50 per cent died within 12 months, it is not unreasonable to assume that the same high percentage of deaths was maintained in those cases reported well but not followed. The one case reported well 3 years after operation but not followed further could not be considered cured, for in this series we have 1 death from metastasis that long after operation.

CASES FOLLOWED, REPORTED WELL

Of those patients upon whom the follow-up information is complete only 2 are reported living and well more than 5 years after operation. One patient reported by Kraft is well 11 years follow-

TABLE V.—OPERATIVE PROCEDURES, 44 CASES

Operation	No.
Nephro-ureterectomy	9
Nephrectomy and partial resection of ureter	9
Nephrectomy followed by ureterectomy	5
Exploratory laparotomy	4
Nephrectomy followed by ureterectomy and resection of portion of bladder wall	2
Ureterectomy followed by nephrectomy	2
Uretero-nephrectomy	2
Resection of lower end of ureter with portion of bladder wall and transplantation of ureter	2
Prostatectomy followed by nephrectomy and ureterectomy	1
Nephrectomy and splenectomy	1
Resection of lower ureter with transplantation to bladder	1
Resection of lower end of ureter—upper end lost in wound	1
Nephrectomy	1
Nephrectomy followed by exploratory laparotomy and colostomy	1
Nephrotomy followed by nephrectomy	1
Nephrotomy followed by nephro-ureterectomy	1
Nephrotomy	1
Total	44

ing a nephro-ureterectomy for papillary epithelioma of the lower portion of the left ureter. A patient reported by Knickerbocker and Crance is well 8 years after a uretero-nephrectomy for an epithelioma of the lower portion of the right ureter. In the case reported by Stewart the disease was probably arrested, for when the patient died of pneumonia and cardiac failure at the age of 80, 4 years after a nephrectomy and partial ureterectomy for a papillary carcinoma of the middle of the right ureter, there were no symptoms pointing toward a local recurrence or metastases to other organs. The patient reported by Dr. D'Aunoy is well 2 years after a ureterectomy followed by a nephrectomy for papillary carcinoma of the lower portion of the ureter, but of course it is much too soon to draw conclusions concerning the ultimate result in this case.

CHOICE OF OPERATION

The type of operation indicated depends not only upon the location and character of the tumor but upon the patient's condition as well. Where the tumor is small and in close proximity to the bladder it is sometimes possible to resect the involved area and transplant the remaining end of the ureter into the bladder. Also, if from the character of the growth an operator can with reasonable certainty rule out the possibility of implants to the lower portion of the ureter from a small tumor close to the ureteropelvic junction, resection with transplantation of the stump of the ureter into the renal pelvis should be considered, especially if the kidney happens to be worth saving. In cases in which the transplantation is impractical, or in which there is any doubt as to the possibility of tumor implants in the remaining portion of the ureter, the ureter and its kidney should be removed, provided the opposite kidney is functioning satisfactorily. The decision as to whether the operator should perform a uretero-nephrectomy, or a nephro-ureterectomy, or should follow the more conservative method of removing either the kidney or ureter first and the remaining organ as soon as the patient's condition permits, must necessarily be based upon the results of the pre-operative study in each case. If there is any reason to fear that the kidney on the uninvolved side will be unable to carry the burden alone, it would seem advisable to remove the involved ureter and perform a permanent nephrostomy on its kidney. In suspected bladder wall involvement near the ureteral orifice, either by means of direct extension or a tumor implant, this area with a safe margin should be removed with the ureter. Because of the extremely high mortality in late stages of this disease, an exploratory operation seems justifiable in early cases if this diagnosis is strongly suspected but not clearly proved.

SUMMARY

1. Primary carcinoma of the ureter is a relatively rare disease, there being only 61 acceptable cases in the literature.

2. The most common type of tumor is the papillary carcinoma.

3. The disease occurs with equal frequency in the fifth, sixth, and seventh decades of life. The average age of patients in this series was 55.7 years.

4. The right ureter seemed to be involved slightly more frequently than the left, and the lower third of the ureter was involved in 57 per cent of the cases.

5. Increased knowledge concerning the behavior of this disease, as well as the marked advances in the technique of urological diagnosis, should result in earlier diagnosis.

6. The postoperative mortality in this series was 27 per cent.

7. Of those cases followed, only 2 patients are reported well more than 5 years after operation.

8. Early diagnosis and radical surgical removal offer the greatest chance for cure.

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THE CARE OF THE SURGICAL DIABETIC

A Report of Two Hundred and Two Cases

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THE wealth of literature (1, 3, 5, 7) that has appeared on the care of the surgical diabetic since the discovery of insulin may be taken as a fair index of the increased incidence of surgery in the diabetic and of the increased importance of surgery to the diabetic patient. This increase in surgical complications may be attributed to the increased span of life resulting from the intelligent use of insulin and diet in these patients.

The treatment of the surgical diabetic is still not without difficulty. It is our impression, however, after 4 years' experience on the wards of the Third (New York University) Divisions of Bellevue Hospital, that these difficulties can be reduced to a minimum by the adoption of a routine method of procedure. Such a procedure should be applicable in a general way to all surgical diabetics and yet be sufficiently elastic to allow for the individual case. This report is concerned with the application and results of our method of treatment in 96 patients operated upon and 106 non-operated upon surgical cases.

It seems a bit obvious to point out that to facilitate and expedite the treatment there must be co-operation between the medical and surgical services of the hospital. We have found that this is readily accomplished by having one member of each staff primarily responsible for the treatment of the diabetic patients. So that no time is lost in starting treatment in such cases, the interne staff of both services is instructed in the handling of such patients and is responsible for the urinalyses.

When the operation is one of choice and the patient can be treated by diet for several days before operation, we place the patient on a diet of

Carbohydrate	180 to 200 grams
Protein	70 to 80 grams
Fat	75 to 85 grams

Enough insulin is given before meals to render and keep the patient sugar free.

The immediate pre-operative treatment of the diabetic patient depends on the type of operation, the approximate length of time required for the operation, the type of anæsthesia, and the urinalyses. Actually in estimating the pre-operative dose of insulin, the two most important guides are the urinalysis and the type of anæsthesia that are to be used. The former indicates the degree of ketosis, the latter determines whether the patient will be conscious and able to take food by mouth 2 or 3 hours after operation, without vomiting. We use the following simple guide to estimate the dose of insulin:

Guide for non-ether anæsthesia

Urine sugar	None	Pres.	Pres.	Pres.
Urine acetone	None	None	Tr.	++++
Glucose-dose gms.	35	35	35	35
Insulin dose units.	10	15	25	40

When ether is to be used, the dose of insulin is increased 5 or 10 units. More glucose may be used if desired; we give up to 50 grams.

Time. The glucose is given 2 or 3 hours before operation. If, however, immediate operation is necessary the operation is started sooner and more insulin is given after the operation.

Form of glucose. In operations not involving the abdomen or pelvis the glucose may be given by mouth as orange juice, ginger ale, or tea, with glucose. Whenever it is thought that the patient may vomit or in abdominal and pelvic operations, the glucose is given by infusion—usually in 500 cubic centimeters of normal saline. As a matter of fact, we are now giving the glucose by this method in amputations and in severe infections, such as carbuncles, as the patient is usually dehydrated and we find the infusion a distinct aid in the treatment. If the operation requires more than ¾ of an hour the amount of glucose should be increased to 50 grams and the insulin increased correspondingly.

Postoperative treatment. 1. Immediately after operation, the patient is given an infusion of 1,000 cubic centimeters of normal salt solution containing 50 grams of glucose. An initial dose of insulin is given with this, the amount being determined by the results of the postoperative urinalysis. Almost the same guide for insulin dosage can be used for this as is used before operation. Too much stress cannot be laid on the importance of the urine specimens after the operation. Both the volume of the specimens and the amount of sugar

and acetone present are important. The former is an index of any tendency toward anuria and the latter to the patient's insulin requirement.

2. Feeding of the patient: If the patient is able to take fluids by mouth, feedings are begun 2 hours after the infusion is finished. Our aim is to give 25 to 30 grams of carbohydrate every 2 hours for 4 doses. The carbohydrate must be given in a form that is readily absorbed and not nauseating. We have found the following combinations useful:

a. Orange juice ..... 250 grams
b. Ginger ale ..... 250 grams plus Glucose ..... 5 grams; a bit of lemon juice may be added if this is too sweet.
c. Oatmeal gruel: This is made with 15 grams of dry oatmeal, 200 grams of milk, and 5 grams of glucose.
d. Hot tea with 10 grams of glucose and 3 Uneeda biscuits.
e. 200 grams of milk and 3 Uneeda biscuits.

After the feedings every 2 hours, the interval of time between feedings is extended to 3 hours. In this way the patient receives 200 grams of carbohydrate in the 24 hours. The character of the food may be altered somewhat at this time and protein may be added to the feedings as desired, principally in the form of egg white. Usually at the end of this time the patient is able to tolerate a semisolid diet and he is started on:

Carbohydrate ..... 180 grams
Protein ..... 70 grams
Fat ..... 75 grams

In addition, he is given 20 grams of carbohydrate in the form of orange juice at night, about 11 p.m., to avoid the long interval between supper and breakfast. In some cases, if the patient is a very severe diabetic, these feedings of carbohydrate are necessary between the other meals as well or it may be necessary to give two feedings at night, one at 10 p.m. and one about 2 a.m.

When patients cannot take food after the operation, glucose must be given by infusion, clysis, or by rectum. The best method is to give two infusions, each containing 50 grams of glucose in 1,000 cubic centimeters of normal salt solution, and two clyses, 1,000 cubic centimeters each with 50 grams of glucose. This gives the patient 200 grams of carbohydrate in 24 hours and 4,000 cubic centimeters of fluid, which help guard against ketosis and dehydration. We have, in some cases, continued this treatment for 3 days; usually, however, it is only necessary for 24 to 48 hours. One other method of administering glucose is by Levine tube. The rectal route is somewhat uncertain (6) as far as the absorption of glucose is concerned, but it is, of course, an excellent way of increasing the fluid intake.

3. Postoperative insulin administration: The exact amount of insulin to be given depends on the amount of sugar and acetone in the urine specimens. In very mild cases it is enough to give insulin with every other dose of carbohydrate, in severe cases, with every dose.

a. With the first infusion, if the patient is sugar and acetone free, 10 units of insulin are given. If the patient continues sugar and acetone free, 5 units are given with each 25 gram feeding, and if the patient still continues sugar free, insulin is given only with every second or third feeding.

b. If the patient shows no acetone, but the reaction to Benedict's is a cloudy green, 15 units of insulin is given at the start of the infusion.

c. If the reaction to Benedict's test is green with an orange precipitate or orange, the dose of insulin is increased to 20 or 30 units.

d. The doses with each feeding of carbohydrate are increased in a similar manner, depending on the urinalysis. The effort is naturally to keep the patient from going into a state of ketosis. The patient must be watched carefully. It is impossible to detail the entire postoperative treatment, but an outline of the probable dosage can be given, with orders to modify the treatment according to the urinalysis. Insulin shock *must be avoided* and this can be accomplished only by modifying the amount of insulin according to the results of the urine test. There is nothing alarming if small amounts of sugar are present in the urine. This is quite usual during the first 48 hours. The important thing to avoid is ketosis which is evidenced by the presence of acetone in the urine.

Examples of some of the cases treated:

CASE 1. Carbuncle of neck extending across entire back of neck. Female (M.B.), aged 58 years, had had diabetes for 5 years. On admission to the hospital patient was dehydrated and in impending diabetic coma. Urinalysis showed sugar, 6 per cent; acetone, 4 plus; diacetic acid 2 plus. Examination of blood showed sugar 333 milligrams. To combat the dehydration, a saline infusion of 1,000 cubic centimeters was given with 50 grams of glucose. In addition, the patient was given a clysis of 2,000 cubic centimeters with 100 grams of glucose. Insulin was given in large doses every half hour—a total of 195 units being given before operation during a period of 3 hours. The patient was operated on under ether and gas anæsthesia. Postoperative laboratory examinations showed: of the urine, sugar, 5 per cent; acetone, negative; diacetic acid, negative; of the blood, sugar, 250 milligrams. Treatment consisted of administration of a clysis of 2,000 cubic centimeters with 100 grams of glucose, and during the time it took to give the clysis a total of 90 units of insulin was given. The patient was then put on 2 hour feedings. The patient was in the hospital 59 days. The infection cleared up completely, but the patient always required large doses of insulin.

This was a very severe infection accompanied by profound ketosis and required vigorous diabetic treatment.

CASE 2. Carbuncle of neck. Male 48 years of age. When patient entered the hospital he showed no ketosis and no dehydration. Urinalysis revealed: sugar, 1 per cent; acetone, negative. Blood sugar test was not done. Treatment consisted in the administration of glucose, 35 grams; insulin, 15 units. The carbuncle was excised under general anæsthesia. Postoperative laboratory urinalysis revealed no sugar or acetone.

Patient was given a clysis of 2,000 cubic centimeters—a total of 75 grams of glucose was given and he required only 15 units of insulin with this. Patient proved to be a very mild diabetic requiring only 5 units of insulin daily. He remained in the hospital one week.

CASE 3. Abscess of thigh apparently from insulin infection. Female, 23 years. Duration of diabetes, 3 years. On admission to hospital patient showed a moderate ketosis and dehydration. Urinalysis was negative for sugar; acetone, 3 plus. Blood sugar was 87 milligrams.

Patient was given 35 grams of glucose and 20 units of insulin. The abscess was incised under general anæsthesia. Postoperative laboratory examinations showed urine negative for sugar; acetone, 1 plus. Blood sugar was 74 milligrams.

Patient was given immediately after operation 35 grams of glucose and 20 units of insulin. Fluids were forced by mouth. Patient was able to take her diet the next day but required a night feeding with insulin. Remained in the hospital one week.

CASE 4. This patient was admitted with an infection of the right hand and thumb. On the first operation the infection was incised—on the second operation the thumb was amputated.

E. M., female, aged 27 years. The laboratory findings and doses of insulin were as follows:

	Pre-operative	Post-operative immediately	2 hrs.	4 hrs.	6 hrs.
Blood sugar mgm.	114	110	..	..	..
Urine sugar per cent	1.5%	0	..	..	..
Urine acetone	0	0	..	..	..
Grams glucose given	35	25	25	25	25
Units Insulin given	25	15	15	15	15
Fluids given	Forced by mouth		..	..	..

After the first operation and before the second operation the laboratory findings and treatment were as follows:

	Pre-operative	Post-operative immediately	2 hrs.	4 hrs.	6 hrs.	8 hrs.	9 hrs.
Blood sugar	..	..	..	..	..	..	..
Urine sugar	1%(.76G)	..	..	..	..	..	..
Urine acetone	0	..	..	..	..	..	..
Grams glucose given	35	25	25	25	25	25	25
Units insulin given	15	10	10	10	10	10	10
Fluids given	Forced by mouth		..	..	..	..	..

CASES 5 and 6. Gall bladder.

	G. B.	C. F.
Age, sex:	42, female	43, female
Duration of diabetes:	5 years	7 years
Surgical diagnosis:	cholecystitis	acute cholecystitis
Condition on admission:		
Ketosis	moderate	moderate—carbon-dioxide, 39 per cent
Blood sugar	260 mgms.	222 mgms.
Urine sugar	1.8 per cent	4 plus
Acetone	4 plus	4 plus
Treatment:		
Treated for diabetes for 5 days before operation.		Operated upon within 12 hours
Immediate pre-operative findings.		
Blood sugar	125 mgms.	284 mgms.
Urine	Sugar free	3 plus: acetone, 3 plus
Insulin	15 units	25 units
Glucose	35 grams	35 grams
Immediate postoperative data:		
Blood sugar	79 mgms.	227 mgms.
Urine	Trace of sugar acetone—negative	Sugar 3 per cent acetone 2 plus
Glucose	50 grams	50 grams
Insulin	15 units	25 units
Fluids	Infusion 500 ccm.	750 c.cm.
Course:	Discharged in 37 days	Discharged in 31 days

CASE 7. A. T., male, aged 61 years. Mid-thigh amputation.

	Pre-operative	Post-operative immediately	3 hrs.	6 hrs.	9 hrs.	12 hrs.
Blood sugar	170	114	..	..	..	..
Urine sugar	0	0	0	0	0	0
Urine acetone	0	0	0	0	0	0
Grams glucose given	45	50	30	30	30	30
Units insulin given	10	8	5	5	5	5
Fluids given c.cm.	...	750 (infusion)	..	..	..	..

CASE 8. J. W., male, aged 51 years. Amputation lower part of leg.

	Pre-operative	Post-operative immediately	2½ hrs.	5 hrs.	7 hrs.	11 hrs.	15 hrs.
Blood sugar	81	60	41	..	..	..	..
Urine sugar	0	0	0	..	0	..	..
Urine acetone	0	0	0	..	0	..	..
Grams glucose given	35	50	..	15	50	20	25
Units insulin given	10	15	..	5	..	5	5
Fluids given c.cm.	..	1000 (infusion)	..	..	..	..	..

SUMMARY AND CONCLUSIONS

The diabetic patient should not be denied surgery because of his diabetes. Properly treated he will prove a safe surgical risk. With this in mind surgery in the diabetic should be extended beyond the limited scope of emergency life saving operations. He should be accorded surgery that not only saves life but also makes life more liveable. A hernia or a relaxed perineum may be repaired, an infected gall bladder drained or removed, and a chronic or acute appendix removed as in any other person. In acute infections, surgical interference is particularly indicated in patients with diabetes. Infection is a serious menace to the diabetic patient, so increasing the severity of his diabetes that he may readily go into coma. The diabetes in such cases is an added indication for the removal of the infected part.

Chart 1 shows the number of cases and the types of treatment, with the number of deaths in

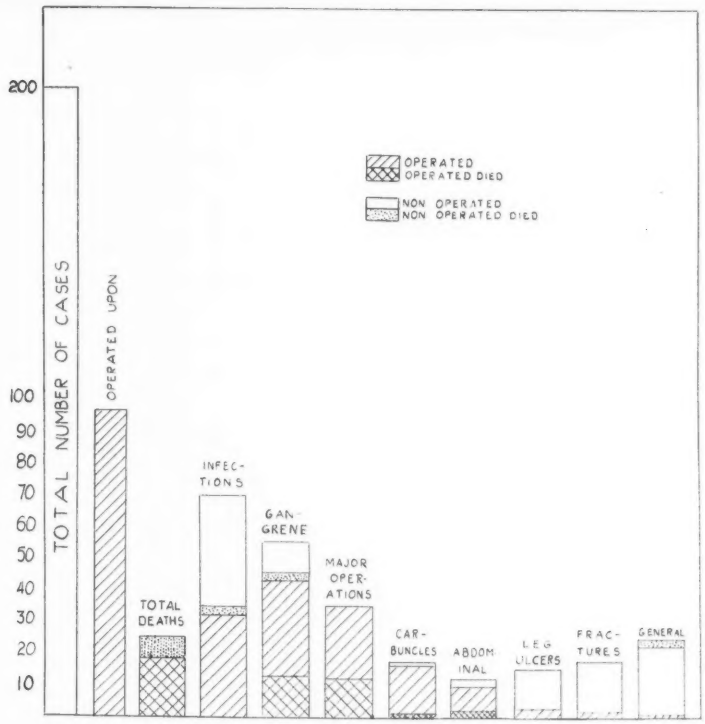

Chart 1. The distribution of cases with deaths in each group.

each group. In our cases, as in those of other observers (3), infection and gangrene were the commonest complications.

Surgical technique in the diabetic patient is in general the same as for other patients. In only one respect does it differ quite markedly. This is in minor surgical procedures such as paronychiæ, felons, infected ingrown toenails, or infected corns. From these, apparently minor surgical conditions, most of the major surgical complications arise. Their onset is due to lack of proper prophylactic precautions. Part of this is the fault of the patient, who knowing he is a diabetic does not take care of his feet or attempts to remove corns himself. Part of the fault rests with the physician. No surgical procedure should be undertaken without first doing a urine test for sugar. The older diabetic patient may not be aware of the existence of the disease. In 35 per cent of our cases the diagnosis of diabetes was made for the *first time* when the patient was admitted to the surgical wards. From the physician's standpoint, once the diabetes is recognized the problem of treatment is simplified. In such patients strong antiseptics are to be avoided. Local infiltration or a nerve block at the base of a digit should never be done in the diabetic patient. A tourniquet should not be used. Any one of these procedures applied to a digit or a

Case 9. M. T., aged 28 years. Graves' disease—thyroid gland removed.

Time	Pre-operative	Immediate postoperative	3 hrs.	5 hrs.	9 hrs.	12 hrs.	15 hrs.	20 hrs.	21 hrs.
Blood sugar mgm.	61	111	74	....	...	...	...	...	181
Urine sugar gms.	0	0	0	Tr.	0	0	...	...	0
Urine acetone	0	0	0	0	Tr.	Tr.	...	...	0
Treatment									
Glucose gm	50	50	..	50	20	20	25	25	25
Insulin units	20	10	..	10	8	5	8	8	5
Fluid by									
Infusion c. cm.	500	1000	..	1000	...	...	...	...	...
Mouth c. cm.	...	....	..	.....	200	200	250	250	250

limb already the site of vascular inadequacy will produce sufficient additional trauma and pressure occlusion of the vessels to cause gangrene. All such minor procedures should be done under gas oxygen anæsthesia.

As to anæsthetics, the most desirable is the one that leaves the patient conscious following the surgical procedure. Any anæsthetic that tends to produce liver damage (2) is particularly to be avoided. This means specifically chloroform and to a somewhat lesser degree ether. For surgery not involving the abdomen, we prefer gas oxygen; for laparotomies we prefer to use subarachnoid block. We have had no experience with ethylene. Avertin may be used, but preferably only as a basal anæsthetic, to be supplemented with gas oxygen.

In the past 4 years we have admitted 202 surgical diabetic patients. In these there was a mortality of 12 per cent. Of this total 96 came to operation. The mortality in the operated upon cases was 16.4 per cent. The operations included amputations, carbuncles, laparotomies for acute empyema of the gall bladder, cholelithiasis, acute appendicitis, and a group of elective surgical cases. In 36 major amputations there were 12 deaths. Four of the patients who died were extremely ill on admission. Of the amputations, five were done below the knee after the method described by Dr. Beverly C. Smith. None healed by primary union. All healed in 8 to 10 weeks. None required skin grafting and none required reamputation. In 16 radically excised carbuncles there were 2 deaths.

The non-operated upon group included some patients who refused operation, and some in whom palliative treatment was advised. Of the 15 cases with gangrene not operated upon 3 died, the others were treated with a cradle, dry heat, and when the infection subsided, with Buerger's exercises. The results in the 12 remaining cases were moderately encouraging, but it remains to be seen how long these patients will continue to have an adequate vascular supply to the extremity involved. When patients with infections were not operated upon they were treated with wet dressings and rest in bed, with satisfactory results. Fractures were not counted as operations, as the setting of a fracture causes no particular disturbance to the diabetic patient.

The cause of death following surgery in the aged diabetic is not primarily due to a disturbed carbohydrate metabolism, but rather to the diffuse arteriosclerosis. This may involve all their vessels, cerebral, coronary, and renal as well as those of the extremities. Only those of the extremities are amenable to surgical treatment and the diffuse vascular inadequacy is still beyond our scope. Their death is often one of circulatory failure, kidney insufficiency, or cerebral accident.

Only in the severe infections is the treated surgical diabetic liable to die of his diabetes. In none of our cases can we truly hold the diabetes itself immediately responsible; that is, none of our patients died in coma. However, the treatment in severe cases is vigorous and an individual who has had a disturbed carbohydrate metabolism with the consequent disturbance of fat metabolism has profoundly upset the chemistry of the body. The readjustment of this is sometimes difficult and, for this reason, any additional burden such as insulin shock, should be avoided.

For the most part, however, the treatment of the surgical diabetic is not difficult. It requires a little more effort and care on the part of the physician—and it necessitates frequent urinalyses. As is so often the case, when a routine for such treatment has been established and the importance realized, one is hardly conscious of the additional effort.

We are indebted to Dr. Harold Brandaleone for his assistance in working up these cases and in tabulating the results.

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FIVE YEAR RESULTS OF SUPRAPUBIC RADIUM IMPLANTATION INTO BLADDER TUMORS[1]

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THE case histories that form the basis of this paper constitute a continuation of the histories of 31 patients with bladder tumor treated by suprapubic implantation of metal capsules (which are referred to in the text as radons[2]) containing radium emanation. These 31 cases have been previously reported and the method of operation described.[3] They are the first 31 cases operated upon by me by this method. The operations were performed between December, 1925, and March, 1928. The 5 year results of these operations are quite gratifying in spite of the fact that four cases have been included (Cases 4, 15, 16, 17) whose initial treatments were made by resection (Case 4) or by radium implantation through less satisfactory methods, 2 with glass seeds and 2 with steel needles containing radium element. All these 4 patients have died of carcinoma.

Moreover, many of these patients received a lower dosage of radium than would be employed today. We now use 2 millicurie radons[4] in place of the 1 millicurie or 1.5 millicurie radons that we employed on so many of these patients. One (Case 13) definitely had insufficient radiation. The tumor was controlled for 2 years. Quite possibly had a larger number of radons been implanted the ultimate result might have been better.

For these reasons and because of what seem more promising results obtained on patients who have been operated upon since this series, we feel that the results here presented are minimal.

In the previous report 2 deaths from operation are recorded, one 3 days after suprapubic implantation of radium, the other a death due to ileus following resection of the bladder for persistent tumor of the vault after repeated radium implantation had failed.

This is the only resection performed in the series, and so excellent have been the results of radium implantation that in the intervening years but 2 cases have been resected and 1 submitted to total cystectomy. All of the other operable cases have been treated by radon implantation if they were too extensive or too malignant for fulguration.

[1] J. Am. M. Ass., 1933, c, 1765.
[2] Tr. Am. Ass. of Gen.-Urin. Surg., 1928, xxi, 137. J. of Urology, 1927, xvii, 205. Arch. Franco-Belges de chir., 1928, August.
[4] Screen of 3 m.m. gold.

RESULTS

In the previous report results were tabulated after dividing the cases into four groups; papilloma and grade I, grade II, grade III, and grade IV. The typing was done by a combination of clinical and pathological observations somewhat similar to that employed by Dr. Barringer in 1928. In most instances slides of the tumors were preserved and have been subsequently graded by the American Urological Association Carcinoma Registry. The results are instructive. Three cases (Cases 1, 2, and 3) that had been previously graded I, were placed by the Registry as a papilloma, a grade II and a grade III. The 2 cases (4 and 5) graded II were placed as grades I and I plus. The 12 cases graded III (6 to 17) were again graded III with 4 exceptions which were graded II. The 14 cases graded IV (18 to 31) which grossly and palpably infiltrated the bladder wall with hard masses of tumor 11 were regraded, as III and IV with one exception, graded as II and of interest as the only survivor in this group. A brief history of this patient seems worth repeating.

CASE 29. Male, 67 years of age, had had intermittent hæmaturia 2 years. Bimanual examination revealed a vague resistance and thickening in the bladder region. Cystogram showed the bladder pushed to the left. Cystoscopy was interfered with by bleeding. There seemed to be an infiltrate all across the base of the bladder.

In March, 1927, under spinal anæsthesia, the bladder was opened and "an infiltrating tumor was found which when first seen appeared as a papillary growth surrounding the urethra and growing chiefly from the right side of the trigone and adjacent bladder wall—its base extended about 3 by 3 centimeters to the right of and below the urethral orifice and all the way around in front of the urethra and about 2 centimeters up the right side of the bladder along the line of the ureter. Thirty radons of 1 millicurie each were implanted in the growth with counter pressure by finger in rectum to identify the depth of the growth which in only one place seemed to need one radon deeper than another." Bladder sutured without drainage, broke open on the sixth day, healed on the twenty-sixth.

In February, 1928, there was a recurrence of a most malignant looking type on the opposite side of the bladder. The mucosa was lifted up and the tumor seemed to break through it. Into this 4 radons each containing 2.5 millicuries were implanted through the cystoscope. Specimen reported grade II.

Repeated negative cystoscopies were made since that time, the last in September, 1932, 5½ years after operation and 4½ years since the operative cystoscopy. The patient reported himself well by letter in May, 1933.

The cases herein reported were previously reported in the Tr. Am. Ass., Genito-Urin. Surg., 1928, xxi. In order to avoid confusion the case numbers in that communication have been retained in this.

It is interesting to compare the prognostic accuracy of the older methods of more or less combined clinical and pathological malignancy with the modern grading. According to the older classification there were 8 tumors in grades I and II. Of these only 1 died (12.5 per cent). There were 12 grade III tumors, 2 died of operation and 3 of carcinoma, making an almost 50 per cent mortality. One of these patients lived 3½ years, another 3 years from the original treatment. Thirteen of the 14 clinically grade IV patients died of carcinoma, 1 after 27 months, 1 by suicide because of blindness due to wood alcohol but with the fistula still open (Case 30) and very likely with tumor still in him 3½ years after operation, and 1 remained well and working 6 years and then died of carinoma; while Case 29 cited is the only survivor.

In contrast to these the American Urological Association pathological grading omits 1 of the cases as a papilloma (surviving) and 7 as ungraded (5 died of carcinoma: Case 22 in 3 months; Case 24 in 4 months; Case 27 in 11 months; Case 4 in 2 years; Case 30 committed suicide at 3½ years, fistula still open and carcinoma probably present; while 2 survived and are well over 6 years) and classes the others as follows:

There are 2 grade I: 1 well after 3½ years (cystoscopy) and then lost sight of; 1 well 5½ years.

There are 6 grade II: 1 patient cystoscoped and found free from tumor 5 months after operation and then lost sight of; 3 others well at the end of 4, 5½, and 6½ years; 2 died (Cases 15 and 16) each of whom had the original treatment by radium element and not by radons.

There are 12 grade III: 3 survivors, 2 operative deaths, 7 cancer deaths (at intervals of 5, 7, 8, 13, 18, and 27 months, and 3½ years), survivors well and free from cancer at 5½, 5½ and 6 years (the 6 year survivor was graded III plus).

There are 3 grade IV; all died of carcinoma, 1 at 7 months, 1 at 13 months and 1 at 6½ years (Case 31). This man had remained at work and supposed himself well for 6 years after the radium implantation.

No deaths by intercurrent disease.

The mortality for the whole series (by operation, 2; by carcinoma, 17) was 61 per cent, the 5 year cures 29 per cent. Excluding the 7 ungraded cases and Cases 15, 16, and 17, the treatment of which was begun by earlier methods, and the papilloma (Case 3, well 6 years), the graded cases are classified as follows:

In grades I and II, were 6 cases, no deaths; 1 cure verified 5 months, the others 3, 4, 5 (twice), 6 years.

In grade III, were 11 cases: 1 operative death, 7 carcinoma deaths, 3 cures followed over 5 years (mortality 73 per cent; 5 year cures 27 per cent).

In grade IV, were 3 cases, all dead within 7 years.

The discrepancy between the results of the clinicopathological grading of 1928 and the American Urological Association grading here reported is not great in sum but is important in detail. To this day I cannot clinically distinguish papilloma from grade I, II, or III carcinoma, nor, in the clinically infiltrating group, grade II from III, or IV. Case 29, cited, seemed to me as malignant a case as I had ever seen. Grading and survival proved me wrong. Subsequent experience confirms the impression that tumors microscopically grouped under grades I or II are almost as curable by radium as papilloma and should scarcely fall within the popular conception of cancer. Metastasis occurs so late that almost the most neglected cases should be curable by cystectomy.

Unfortunately, the majority of bladder tumors that have seemed to me malignant enough or extensive enough to merit open operation are of grades III or IV (60 per cent of this series) and when these have become so extensive as to merit cystectomy, metastasis may almost be assumed to be present, reducing even cystectomy to the rank of a palliative operation.

CASE HISTORIES

CASE 1. Grade II. Ch., male, 72 years old, had had symptoms 2 years. He was operated upon in February, 1926; 5 radons of 2 millicuries each being implanted. Last cystoscopy was done in September, 1927. He was last heard from in September, 1932; he had been well, 6½ years after operation.

CASE 2. Grade III. Me., male, 74 years old, had had symptoms 6 weeks. He had multiple tumors, and had been operated upon in April, 1927. Twenty radons of 1.5 millicuries each were implanted. He was well in September, 1932, 5½ years after operation.

CASE 3. Papilloma. Schr., male, 64 years old, had multiple tumors, and was operated upon in December, 1926. Twenty 1 millicurie radons were implanted. Last cystoscopy was done in February, 1933. He has remained well 6 years after operation.

CASE 4. (Not graded). Cr., female, 82 years old. The bladder was resected for tumor in 1918. In 1922 and the following years fulguration and cystoscopic radium implantation were administered. She came to me in 1926 with a small, soft, papillary tumor about the right ureteral orifice. After several months of vain cystoscopic efforts, in August, 1926, the bladder was opened and 5 radons containing 1.5 millicuries each were implanted. She was a difficult patient. The tumor reappeared in October, 1927. In spite of cystoscopic treatments the growth spread over the bladder and in January, 1930, she died of carcinoma, almost 3½ years after the operation.

CASE 5. Grade I. Mo., male, 39 years old, had had symptoms 1 year. An extensive growth was present in the bladder and posterior urethra. Operation was done in December,

1926. Eleven 1 millicurie radons were implanted. A small recurrence was fulgurated 3½ years after operation. Six months later active pulmonary tuberculosis appeared; she had lost 10 pounds. Last cystoscopy was done in May, 1933. No tumor was present. Patient was well and tuberculosis had been controlled.

CASE 6. Grade I. Ro., male, 55 years old, had had symptoms one year. He had extensive multiple tumors. Operation was done in October, 1926. Eleven radons of 1.5 millicuries each were implanted. Numerous postoperative fulgurations were applied to five distinct recurring tumors, one of them within the urethra. The recurring bladder tumors were cleared up by November, 1929, but the urethral tumor persisted. Four hundred millicurie hours of radium emanation in a catheter tied in the urethra (125 millicuries) in August 1929 partially controlled this and a month later it was destroyed by fulguration. November, 1929, a recurrent bladder tumor was burned off and in April, 1930, the bladder and urethral tumors were again burned. In October, 1931, a one stage suprapubic prostatectomy was done; the fistula was closed in 14 days. Incontinence of a few drops of urine followed operation and persisted. In December, 1932, cardiac decompensation prohibited his getting about. Last cystoscopy was done in November, 1932, but no tumor was found. Patient was last seen in May, 1933, and was completely inactive because of heart but he empties bladder, holds urine 2 to 4 hours, has no symptoms of tumor, 5½ years after operation and 3 years after the last cystoscopic treatment.

CASE 7. Grade III. On., female, 76 years old. Operative death.

CASE 8. Not graded. Gr., female, 67 years old, had a tumor of the lower end of the ureter and bladder following nephrectomy for papillary carcinoma of kidney pelvis. Cystoscopic treatment failed. Operation was done in July 1926. Twelve 2.5 millicurie radons were implanted. No postoperative treatments were given. Cystoscopy 17 months after operation was negative. She was last seen well 6½ years after operation.

CASE 9. Grade III. Schw., male, 55 years old, had had symptoms 7 months. Operation was done in May, 1927. Fifteen 1.5 millicurie radons were implanted. No postoperative treatments were given. Cystoscopy was negative and patient was well in November, 1932, 5½ years after operation, when he was 60 years of age.

CASE 10. Not graded. Bul., male, 60 years old, had had symptoms 6 months. Operation was done in November, 1926. Fourteen 1.5 millicurie radons were implanted. No postoperative treatment was given. Last cystoscopy was done 4 years after operation. He was well 6 years after operation, November, 1932.

CASE 11. Grade II. Ca., male, 48 years old, had a tumor of the bladder and urethra, with symptoms for 7 months. Cystoscopic treatment irritated the bladder. Operation was done in November, 1926. Fourteen 1.5 millicurie radons were implanted. The urethral tumors were fulgurated in May, 1927. There was an arteriosclerotic bladder ulcer (post-radium) in March, 1928, but no tumor. He was well in December, 1930, 4 years after operation.

CASE 12. Grade II. Hi., male, 40 years old, had had symptoms 20 years, with tumors of bladder and urethra. He was operated upon in March, 1928. Twelve 1.5 millicurie radons were implanted. Patient was lost sight of after a negative cystoscopy in August, 1928.

CASE 13. Grade III. Por., female, 50 years old, had had symptoms 1 year. She was operated upon in January, 1926. The tumor was excised with cautery and 3 platinum radons of 3 millicuries each were placed in the base at least 3 centimeters apart. This was one of the first patients operated upon. It was recognized that the amount of radium was inadequate but no more was at hand. Six weeks later cystoscopy was negative but in May a recurrence was seen and in June, 3 radons of 1.5 millicurie each were implanted in this. Thereafter cystoscopy showed no tumor in September, 1926, and September, 1927. But in August, 1928, a carcinomatous lymph node appeared above the left clavicle and cystoscopy showed a deep carcinomatous ulceration to the right of the fundus. No treatment was given. She died in June, 1929, 3½ years after operation.

CASE 14. Grade III. Ba., male, 54 years old, had had symptoms 6 months. Cystoscopic treatment failed. He was operated upon in December, 1926, when 20 gold radons, 1 millicurie each, were implanted. Three months later cystoscopy showed tumor and 13 radons of 1.5 millicurie each were implanted (operation) into the same growth. Cystocopy was negative in 1930. He was last heard from alive and well in January, 1933, 6 years after operation.

CASE 15. Grade II. Pa., male, 54 years old, had had symptoms 2 months. He was treated first in September, 1925, by suprapubic section and implantation of 6 steel tubes each containing 3 millicuries of radium element. A recurrence at the same spot was controlled by implantation through the cystoscope in December, 1925, of 3 platinum radons containing 3 millicuries each followed by 5 fulgurations in the next 3 months.

The bladder growth thereafter remained healed but in October, 1926, a urethral neoplasm appeared and this, in spite of many fulgurations and the urethroscopic implantation of one 1.5 millicurie radon in February, 1927, and three 1.5 millicurie radons in September of the same year, continued to grow and extended to the prostate, the patient dying in September, 1930, of secondary carcinoma of the prostate, 5 years after his operation.

CASE 16. Grade II. Fra., male, 44 years old, had had symptoms 15 months. He was first treated in November, 1925, by the implantation of 10 tubes, each containing 2.5 millicuries of radium element. Tumor was uncontrolled. In October, 1926, fifteen radons of 1.5 millicurie each were implanted, in January, 1927, five more by cystoscope and in February, 1927, the bladder was reopened and twenty-five 1 millicurie radons implanted. This resulted in severe radium burn and caused a vesicorectal fistula but did not control the carcinoma of which he died in June, 1929, 3½ years after the first operation.

CASE 17. Grade III. Po., male, 47 years old, had had symptoms 18 months. He died in spite of much fulguration, 3 suprapubic implantations of radium (the first with glass seeds) and a resection of the bladder vault. Death was due to ileus after resection of the bladder, but carcinoma of the bladder was found in the specimen and postmortem no metastasis was found. Treatment was begun in February, 1924, the patient died in May, 1927.

CLINICALLY INFILTRATING TUMORS

CASE 18. Grade III. Buc., male, 54 years old, had had a carcinoma of larynx 2 years previously and 18 months before operation hæmaturia with diagnosis of carcinomatous ulcer. He refused operation until February, 1926, when 6 platinum radons containing 2.5 millicuries each were implanted in an extensive tumor covering the trigone and left bladder wall, its base about 6 by 8 centimeters in diameter. This implantation was obviously inadequate. The patient died of carcinoma 9 months later.

CASE 19. Grade III. Bird, male, 44 years old, had had symptoms 4 months. In February, 1928, operation revealed a carcinomatous ulcer of the base of the bladder 6 by 3 centimeters. Thirty gold 1 millicurie radons were implanted in two layers. Patient died of carcinoma in 5 months.

CASE 20. Grade III. St. Jo., male, 56 years old, had had symptoms for 4 years. Operation in September, 1926, dis-

closed an infiltrating papillary growth, its base 3 centimeters in diameter, extending from above the urethra to the vertex. The infiltration was at least 1 centimeter thick, the projecting tumor of considerable size. Fifteen 1.5 millicurie gold radons were implanted. This was inadequate. He considered himself well until March, 1927, when his symptoms recurred. I refused to re-operate upon him. He was re-operated upon elsewhere and more radium was implanted. He died in June, 1927, 9 months after the first operation.

CASE 21. Grade IV. Scha., male, 59 years old, had had symptoms 7 months. Operation was done in September, 1927. Five gold 1.5 millicurie radons were implanted into the indurated base of a small papillary tumor situated near the right ureteral orifice. The bladder lesion was controlled but the tumor extended into the pelvis and in April, 1928, 7 months after operation, patient died of carcinoma.

CASE 22. Not graded. Te., male, 66 years old, had had symptoms 4 years. The bladder tumors had been fulgurated. In October, 1926, operation was done and revealed an infiltrating tumor surrounding the bladder neck and occupying the trigone. Twenty gold 1.5 millicurie radons were implanted. In January, 1927, 3 months after operation, patient died of carcinoma.

CASE 23. Grade III. Bier., female, 50 years old, had diabetes, with symptoms of bladder tumor for 6 months. September, 1926, operation revealed a hard infiltration extending from the vertex down the right side to the base. The perivesical fat was sclerotic. The lesion was 2 centimeters wide and about 5 centimeters long. There were several secondary tumors. Fifteen gold 1.5 millicurie radons were implanted, but without benefit. In April, 1927, 7 months after operation, she died of carcinoma.

CASE 24. Not graded. Da., male, 72 years old, had had symptoms 5 months. In November, 1927, operation revealed a tumor of the left side of the base of the bladder, its base 3 by 3 centimeters in diameter. Twenty gold 1.5 millicurie radons were implanted. The bladder symptoms were controlled but pains developed 3 months later in the left side of the pelvis, etc., and in March, 1929, 16 months after operation, patient died of carcinoma.

CASE 25. Grade IV. De., female, 70 years old, had had symptoms one year. In February, 1928, operation revealed an ulcerating, infiltrating, papillary tumor of the vault covering the major part of the right wall of the bladder. Thirty 1.5 millicurie radons were implanted, but were evidently inadequate. In May, 1928, 4 2.5 millicurie radons were implanted by cystoscope and in March, 1929, 13 months after operation, she died of carcinoma.

CASE 26. Grade III. Fa., male, 67 years old, had had symptoms 3 or 4 years. In January, 1927, operation was performed. First the peritoneum was opened and it was found that the whole subperitoneal portion of the bladder was infiltrated with carcinoma, the tumor having originally doubtless been in the vault. Twenty gold 1 millicurie radons were implanted into the bladder from its peritoneal surface without opening the viscus. A month later a radiogram showed only 3 radons. The other had doubtless been pushed through the bladder wall and been lost. Accordingly the bladder was opened and 30 gold 1 millicurie radons were implanted. These were evidently inadequate but the immediate result was surprisingly good. Before the second operation he had lost 31 pounds. He regained 21 of these and in November, 1927, the cystoscope showed a much inflamed contracted bladder with an ulcer in the fundus but no definite tumor. He died of carcinoma without recurrence of his grave bladder symptoms in July, 1928, 18 months after operation.

CASE 27. Not graded. Fl., male, 64 years old, had had symptoms 3 months. In February, 1927, operation revealed an extensive infiltrating carcinoma of the left side of the bladder extending from the trigone half way to the apex. Seventeen gold 1 millicurie radons were implanted. The operation gave no relief whatever. In January, 1928, 11 months after operation, he died of carcinoma.

CASE 28. Grade III. Ga., male, 63 years old, had had symptoms about 1 month. In February, 1926, a tumor about 4 by 4 centimeters in diameter at its infiltrated base was implanted with 3 platinum 2.5 millicurie radons. Radiation was inadequate. The symptoms were relieved for a year. In May, 1928, 27 months after operation, patient died of carcinoma.

CASE 29. Grade II. (See text.)

CASE 30. Not graded. Bo., male, 43 years old, alcoholic, syphilitic, had had symptoms of bladder tumor for 6 months. He arrived at the hospital suffering with retention due to clots. In March, 1927, operation revealed an ulcerating tumor of the right side of the bladder neck and edge of trigone, its base infiltrated and 3 by 4 centimeters in diameter. Thirty-two platinum 1 millicurie radons were implanted partly in two layers. An ischiorectal abscess resulted and never healed. In August, 1927, cystoscopic examination showed a granulating area in the region of the right ureter, a specimen from which was reported carcinoma. Accordingly in October, 1927, operation and implantation of 9 gold 1.5 millicurie radons were done. In March, 1928, suprapubic extravasation of urine was opened. In May, 1928, urination was painless; he had gained 10 pounds. He was urinating once at night and every 3 to 4 hours by day; but was still drinking heavily. In June, 1930, the local condition remained about the same. He was developing an alcoholic blindness and was overwhelmed with debt. He committed suicide.

CASE 31. Grade IV. Sm., male, 52 years old, had a perineal prostatectomy 1 year before for relief of hæmaturia. Operation had been successful. The cystoscope showed a tumor to the right side of bladder neck. In June, 1926, 6 gold 2 millicurie radons were implanted in an infiltration 5 by 3 centimeters on the upper quadrant of the right side of the bladder neck. In September, 1926, the cystoscope showed several masses of tumor in this same region. The bladder was again opened and 7 gold 1.5 millicurie radons were implanted. In October, 1926, the cystoscope showed one lesion persisting and through the cystoscope 4 gold 1 millicurie radons were implanted. Thereafter patient remained well and free from symptoms and at work until the spring of 1932 when his bladder symptoms recurred, his pelvis was found full of carcinoma, and he died in August, 1932, of carcinoma, 6 years after his operation.

SUMMARY AND CONCLUSIONS

1. The American Urological Association Registry amply justifies its existence. It gives a sound basis for comparison between case reports and a sound measure of progress in our therapy.

2. All epithelial tumors of the bladder graded as I or II should be attacked as curable by fulguration, radon implantation or cystectomy unless moribund or inoperable for other reasons.

3. Grade III has a bad prognosis. We can report but 23 per cent 5 year control. Most of the cancer deaths occur in the first two years.

4. The prognosis of grade IV is even worse. Yet one patient has remained at work and

apparently well for 6 years—and then died of cancer.

5. No attempt has been made to compare cystoscopic fulguration or radon implantation with suprapubic radon implantation. During the period within which these 31 patients were operated upon 6 patients were seen who were deemed too far gone for operation and radons were implanted through the cystoscope into 7 others—and cystoscopic fulguration was sufficient to cure "about a dozen" others (for these I have no exact figures). Thus during this period more than half my bladder tumor patients submitted to suprapubic implantation of radons. Thanks to the practice of suturing the bladder without drainage the postoperative mortality and discomfort are slight. Thirty-seven radon implantations are here reported with but one postoperative death. (The second postoperative death followed resection of the bladder.) The atrocious postoperative spasms that follow the implantation of glass seeds do not occur. Twenty-seven of the operations were followed by no more discomfort than is to be expected after any cystotomy. The 6 patients who required more than one operation submitted to the second operation without comment.

6. Comparison between resection of the bladder and radon implantation for the treatment of the more malignant tumors cannot be attempted on the basis of the cases reported here. Cure of a localized tumor is possible by either method. Resection is not applicable to tumors about the trigone or bladder neck, though these present no peculiar difficulties to radon implantation. Ureteral reimplantation does not have to be considered. The operative mortality is much lower, the stay in hospital so much shorter as to pay for the radium. (In this series 11 were drained and of the 26 sutured without drainage, 11 broke open. For the 15 who did not leak the average postoperative stay in hospital was 15 days, for the others the postoperative fistula stayed open on an average of 23 days.) It is to be hoped that the durability of radium cure is no longer questioned. I have reported 2 patients relieved for over 10 years.[1]

7. At the other limit of malignancy, in the treatment of tumors of grades I or II, the high frequency current competes with radium for use by suprapubic section just as it does for cystoscopic use. Indeed the current offers the most convenient method of removing the growth preliminary to implantation. For the treatment of minor degrees of malignancy the choice is perhaps of no great importance. But whether applied through the cystoscope or through the suprapubic wound, radium destroys malignant tumors that fulguration does not control.

[1] Surg., Gynec. & Obst., 1933, lvi, 462–463.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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FEBRUARY, 1934

THE PSYCHOLOGY OF OPERATIVE MORTALITY

A REAL psychological element is involved in the matter of surgical mortality. The surgeon should keep in mind constantly the mortality rate in the different surgical procedures in his hands. It is true that in certain years there will be many more serious cases which will require operation and the mortality for such years will be greater than in other years; nevertheless, the yardstick, by which one may measure surgical skill, surgical judgment, and the protection with which the patient is surrounded, is mortality.

Mortalities are in some measure related to the surgeon's state of mind. If a surgeon believes that a certain number of patients are doomed to die following surgical operations, then it may naturally follow that a certain number of deaths will occur. The psychological state to which I particularly refer is thus confirmed. If the surgeon is prepared to expect mortalities, he has in some measure compromised his conscience to their occurrence. It is my opinion, that the surgeon's attitude should be that the patient should not die following a surgical procedure, but that if he should die, the surgeon should assume with reasonable exceptions, that an error in judgment has been made (1) in advising an operation at all, (2) in the extent of the operation, (3) in some technical detail of the procedure, or (4) in the pre-operative or postoperative management.

I realize that my attitude may be an impracticable or ideal one from the point of view of actual attainment. On the other hand, part of the ability of a good surgeon should be not only the technical accomplishment of operative procedures, but the selection of an operative procedure which offers the patient the opportunity of relief without an unjustifiable risk. It is extremely easy in surgery, particularly when dealing with patients who are in desperate condition, to justify in one's mind desperate risks, but only very occasionally in my experience, do desperate risks accomplish very much which is worth while.

Consider for a moment the application of these principles to the handling of malignancies. As I review my own experience with malignancies, some of my most disastrous results have been related to applying radical operative procedures in patients who were, as far as cure goes, probably hopeless from the beginning. Such a situation illustrates very well the principle involved in these remarks. Given a patient with malignancy, if the risk be desperate, then in general, with an occasional exception, the chances of cure are relatively slight. The best results are in those cases in which the indications for radical surgery are drawn quite sharply. Radical,

extensive surgery is applicable, certainly justifiable, only in those patients in whom there is a reasonable hope for the complete eradication of the disease and the prevention of a recurrence, or definite hopes for prolongation of life without an undue immediate operative risk.

The tendency is not unhesitatingly to face disagreeable mortality rates. This is particularly true if the surgeon assumes that a certain mortality is inevitable. When the operator knows the mortality rates and frankly faces the risks involved he has the advantage of being acutely aware that he must make no errors in judgment and that he must stimulate everyone who is connected with the operative procedure to his utmost efforts, before and after operation to prevent the occurrence of a mortality. FRANK LAHEY.

HEAT IN TREATMENT OF PELVIC INFLAMMATION

RECENT study has shown that the majority of women who have inflammatory disease of the pelvis are in the third and fourth decades of life, a period in which the physiological activity of the reproductive organs is greatest. The disability incident to inflammation of the pelvis, therefore, is not only that which results from infection itself, but from the train of events which results in disturbance of the ovarian function secondary to the infection, especially during early adult life.

For many years women who suffered from this condition were treated as acute surgical emergency cases, and all or part of the generative organs were removed. The mortality and morbidity were excessive, so that other methods of treatment have from time to time been advocated and directed principally toward reduction in mortality and conservation of the pelvic generative organs. Simpson, in 1909, perhaps exerted the greatest influence in the trend away from radical and toward conservative treatment, by reporting a series of 456 cases in which surgical treatment was given, with a mortality rate of 1 per cent, following a period of conservative treatment. The mortality rate that accompanied the then established plan of immediate operation was 15 to 20 per cent. Simpson maintained that the patient should have recovered from the acute attack before any operation should be performed; the temperature should have been normal for approximately 3 weeks after examinations of the pelvis, thereby indicating complete absorption of the inflammatory exudate.

Subsequently, similar observations were recorded by other investigators. Crossen adequately distinguished the physical findings of infection of the pelvis due to the gonococcus from those due to infection by the streptococcus, and stressed the dangers of any surgical procedures for many months if the latter infection was present. Curtis concluded from his researches on salpingitis that fallopian tubes infected by the gonococcus became sterile approximately 15 days after the symptoms of the acute infection had subsided, and that if symptoms reappeared later, they were due to reinfection and not to exacerbation of the original infection. If reinfection could be avoided in such cases, he postulated that clinical cure could be obtained by conservative measures in 85 per cent of the cases; furthermore, he said, the surgical procedures necessary in the remaining 15 per cent of cases should be directed toward conservation of tissue rather than toward its complete removal. Through the combined efforts of these investigators, and many other able gynecologists, the era of conservative treatment of pelvic inflammatory disease was established.

Application of heat in the vagina for varying periods has been one of the principal factors in conservative treatment. Its use in some form has been increasing progressively. Early medical records refer to the hot vaginal douche as a cleansing agent used for the relief of pelvic pain. Also, German physicians heated shot and poured them into the vagina in order to maintain heat for a prolonged period. The therapeutic effect of prolonged and sustained heat, applied by vaginal douche, was enhanced by the observation of Gellhorn that the mucous membrane of the vagina could tolerate much higher temperatures than the skin of the perineum and vulva.

Realizing the marked beneficial effect of heat in inflammatory disease of the pelvis, efforts were directed toward perfecting methods by which heat could be automatically varied according to the tolerance of the patient and the severity of the inflammatory disease. First among these methods of applying heat was the medical diathermy current, and later, the Elliott technique. Medical diathermy has been, and still is, used rather extensively with beneficial results. Cherry was able to obtain either cure or improvement in 72 per cent of cases in which the temperature varied from 104 to 122 degrees F. These results have been duplicated and confirmed by Scheffey and Schmidt, Gellhorn, and Bettman and Crohn. Use of the procedure was somewhat limited, however, on account of the costliness of the apparatus; furthermore, considerable knowledge of the diathermic current was essential. This led to a desire for a simplification of technique and to one by which heat, when applied in the vagina, would be radiated in all directions, over a greater surface area. The method devised by Elliott satisfied these requirements. Its principal advantage over preceding methods is that the heat is derived from a current of hot water which is circulated through a soft, distensible rubber bag which, when applied, fits snugly around the cervix. The pressure and temperature of the water within the bag are controlled by an electric motor and thermostat. In the average case, the treatment is begun with the temperature of the water about 110 degrees F. and this is gradually increased to 130 degrees F., depending on the patient's tolerance. Daily treatments lasting half an hour to one hour are given as a routine. From ten to fourteen treatments meet the average requirements in most cases.

The therapeutic effect of the heat is shown by marked hyperæmia in the pelvic tissues, increase in leucocytosis, profuse discharge from the cervix and vagina, and gradual decrease in pelvic pain. At a temperature of 130 degrees F. for one hour, the temperature in the vagina, uterus, rectum, bladder, and pelvic peritoneal cavity is increased 5 to 7 degrees F., without any disturbance in the general temperature of the body.

The rapidity with which induration in the broad ligaments and often fluctuation in the cul-de-sac and adnexal regions, disappear following a few treatments with sustained high temperatures often is remarkable. Cases in which, previously, surgical intervention would have been considered are definitely removed from the group of surgical cases. Of 23 cases of pelvic abscess reported by Holden and Gurnee, in only 3 cases was drainage required following treatment by the Elliott technique. Furthermore, when heat was used as a pre-operative measure, the extent of operative interference necessary was considerably reduced, and the amount of tissue conserved was increased.

At The Mayo Clinic a study recently was made on a series of cases in which infections of the pelvis were chronic, and in which the

Elliott principle of application of heat was used. The treatment was used both as a preoperative and as a postoperative measure. Clinical cures were obtained in 70.83 per cent of the cases in which surgical procedures were not employed, whereas the postoperative benefits, such as the shortened period of convalescence, the rapid absorption of exudates, and the reduction in morbidity, were classified as excellent in 100 per cent. Furthermore, the treatment served as an invaluable aid in separating the definitely surgical cases from cases in which clinical cure could be achieved by conservative measures. Also, in a high percentage of cases that were persistently refractory to conservative treatment, other pelvic pathologic changes, such as myomas, cysts, and teratomas, were associated.

It is to be hoped that these results, and similar results reported by others, will help to bring about a greater degree of conservatism in the treatment of pelvic inflammatory disease, and thus contribute to a lower mortality rate, reduction in morbidity, and conservation of pelvic organs, especially of young adult women.

VIRGIL S. COUNSELLER.

MASTER SURGEONS OF AMERICA

DAVID PRINCE

IT is altogether worth while to pause occasionally and think of the pioneers who hewed and wrought in this great Mississippi Valley. What was the "American Dream" which possessed them to cross the mountains; undergo the hardships and dangers of building a new country on new ideals? This great West is ample evidence of how well that dream has come true.

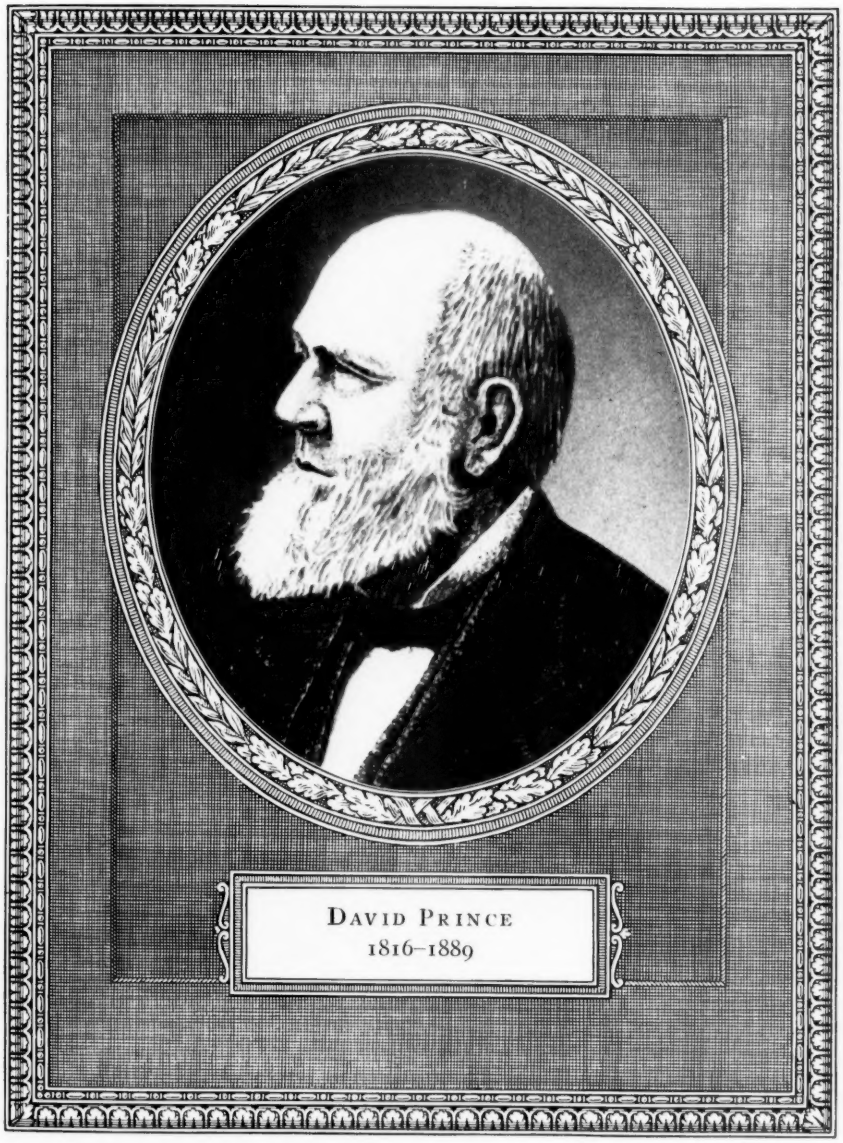
David Prince belonged to one of those families of New Englanders that dreamed and "went west" to Illinois. Born in Brooklyne, Connecticut, June 21, 1816, educated at the Canandaigua Academy in New York, and with one year's study of medicine at the College of Physicians and Surgeons in New York City he journeyed to Cincinnati, Ohio. He spent one year at the Ohio Medical College and graduated probably in 1838.

A most fortunate incident of his life was his association for a year and a half with Dr. Reuben D. Mussey of Cincinnati. Dr. Mussey also a New Englander had been a teacher of surgery at Dartmouth and Bowdoin before coming west. Before graduating at the University of Pennsylvania in 1809, Mussey had done a piece of original research which disproved the theory that the skin had no power of absorption. He was the first to show that an intracapsular fracture of the hip could make bony union; the first to ligate both common carotid arteries; and the first (1837) to remove both the scapula and clavicle for sarcoma of the upper arm.

Thus David Prince was thrown at once under the influence and inspiration of one of America's great surgeons and teachers. That he improved this opportunity is amply demonstrated by his future career.

While in Cincinnati Prince became acquainted with Samuel D. Gross, who was teaching in another medical school there. This acquaintance continued and is attested by Gross's warm words of appreciation of the writings of Prince in the fields of plastics and of orthopedics.

About 1840 Prince followed his family to Payson, Adams County, Illinois, where he practiced medicine and surgery for three years. In 1843, Illinois College added the department of medicine to its course, and David Prince was called to the chair of anatomy and surgery. Thus he became the first teacher of surgery in a medical college in Illinois.



DAVID PRINCE
1816–1889

Jacksonville Sanitarium, David Prince's private hospital, 1865–1889.

When this school was discontinued in 1848 he moved to St. Louis, and lectured on surgery at the St. Louis Medical College. Here he formed a life long friendship for Dr. John T. Hodgen another of the great pioneer surgeons of the Mississippi Valley.

In 1852 Doctor Prince returned to Jacksonville, Illinois, and took up the independent practice of surgery. During the Civil War he served as brigade surgeon in the Army of the Potomac. When his men were captured and sent to Libby Prison, he voluntarily went with them. After the war he was in the office of the Surgeon General for a year assisting in the preparation of the medical and surgical history of the Army of the Potomac.

In 1866 he opened a private hospital in Jacksonville in order to provide facilities for his surgical patients.

Doctor Prince, twice read papers before the International Medical Congress, once in Copenhagen and once in London. He was at least twice a medical visitor and student in the hospitals and clinics of London, Glasgow, Paris, and Berlin.

The diaries he kept during the Civil War and on his trips abroad well illustrate his studious habits. Nothing escaped him. His visit to Paris in 1884 was at the time the French were attempting to prove that surgical infection was due to the micro-organisms in the air. After his return home he built an elaborate operating room in which all the air was filtered through many layers of cotton before it reached the field of operation. While such operating rooms represented an advance in surgical thought regarding infection, contact infection soon captured the field and gave the air-borne theory a subordinate position.

David Prince was short in stature, heavy in body, with a large head and an open countenance. He had little to say. He kept his thoughts and plans to

himself until they were really needed and then he described and explained them in few words. On the other hand, he was a man of wide reading and wide interests. Everything in the community, state, and county attracted his interest. He read German and French and had a good acquaintance with Latin. His surgical methods were truly Hunterian. He always maintained a dissecting room and worked in it. Every new operation was worked out on a cadaver. He always had the courage of his convictions, but was blunt and far from diplomatic in their statement and execution. This trait no doubt had something to do with prematurely closing the Illinois College Medical School. It was the anatomy question. He believed every student should understand anatomy. Dissecting material had to be supplied—law or no law—and he supplied it whether the community liked it or not.

While in St. Louis he had as a room-mate a former Illinois College Medical student, Dr. Samuel Willard. Willard wrote me that "in 1850 Prince received an English Medical Journal mailed to him from England. He scanned its pages, then tossed it aside saying 'I don't see why anybody sent me that.' I took it up and found a short article giving the names of ten surgeons who had, up to that time successfully removed ovarian tumors. The name of David Prince was among them." It was characteristic of him to try everything new. He was among the first in Illinois to use ether as an anæsthetic.

When preceptors were the order of the day he was preceptor to many prospective doctors. Central Illinois was dotted over with physicians who had studied with Prince and were proud of it. He always had from one to six students about his offices. He took an active interest in them and supervised their study but never accepted a fee for such service.

He was an active member of, and a contributor to, many medical societies; he wrote and published numerous medical papers; he was one of the early members of the American Medical Association, the Illinois State Medical Society, and the American Surgical Association; and he was the author of several books among which we list the following: *Orthopedics: a Systematic Treatise upon the Prevention and Correction of Deformities* (1866), *Plastics: a New Classification and a Brief Exposition of Plastic Surgery* (1868), *Plastics and Orthopedics* (1871), and *Galvano-Therapeutics* (1874). All were published by Lindsey and Blakiston.

Doctor Prince was twice married. First to Mary J. Dawson, and two years after her death to Lucy M. Chandler. He had two sons, both surgeons, and one daughter, who married a physician. He died of pneumonia December 19, 1889.

CARL E. BLACK.

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

A UNIQUE monograph[1] by Rothrock records his private practice during the last ten years. It is a careful report of 1750 pregnancies and 1345 gynecological operations, among the author's private patients and is an excellent object lesson in the desirability of keeping accurate case records.

The author follows the conservative obstetrics and gynecology of the present day and the reader must therefore agree with practically every procedure as outlined. Added to this fact is the unusual method of presentation, namely a volume of case reports. This combination makes the book most interesting and instructive.

"That nature is kindly disposed to the expectant mother of the poorer class . . . as her offspring are usually smaller at birth" is not universal. In many of the larger institutions the clinic babies are larger than those in private practice. The difference is due to racial stocks and to geographic distribution rather than to the financial status of the patients. Furthermore, the preponderance of multiparæ in clinic practice will tend to produce larger babies than will the preponderance of primiparæ and secundiparæ of private practice.

Rothrock uses only rupture of the membranes and the Voorhees bag for the induction of labor. Stripping the membranes and castor oil, with or without small doses of pituitrin is such a simple and effective method of induction of labor at or near term, that it is rather surprising that the author does not avail himself of this procedure.

Following delivery under anæsthesia, the patient is allowed to wake up and, after delivery of the placenta, perineal repairs are done under local infiltration anæsthesia. This would seen to be unnecessary. Recent investigations all tend to show that the placental separation occurs more promptly following delivery than was formerly believed. Placental removal and perineal repairs can thus be included in the anæsthesia of delivery thus obviating undue delay or prolonged anæsthesia.

It is pleasing to see that the author does not hesitate to use "properly carried out" vaginal examinations, whenever indicated, and that he sees no difference in the resultant morbidity. In a discussion of this latter, the author describes "54 cases that ran a febrile course." A morbidity of 3.1 per cent is enviable. For the purpose of comparative studies, it would have been most helpful if the author's standard of morbidity had been described, the phrase used being so indefinite that comparisons cannot be made.

The second half of the book deals with gynecology. The procedures described are those in common use in this country with only occasional variations, such as for the correction of uterine retrodisplacement. The author is to be complimented on his results, his low morbidity and mortality and for the careful follow-up of so large a number of patients.

RALPH A. REIS.

LIGHT therapy has been a source of bewildering and hastily written literature. Krusen has rendered the medical profession a real service in bringing to them in his book[2], a clear and concise presentation of the facts of this controversial subject.

The physics of light therapy is most important and it is given here so that a physician with but an elementary knowledge of physics, can readily understand it. The sources of therapeutic radiation used today are considered. The physiological effects and the technique of the application of radiant energy are thoroughly discussed.

There are ten concise chapters dealing with the use of ultraviolet radiation in the various diseases amenable to this form of therapy. The author does not make exaggerated claims for the efficacy of ultraviolet therapy, and advises physicians to read critically the mass of medical literature on the subject and to evaluate such articles on the basis of definitely established facts. As it is impossible for one individual properly to evaluate these claims in so many diverse branches of medicine, the author gives references to original articles and suggests that the student interested in some special subject go to the original sources and investigate the claims for himself.

The book is admirably printed, well illustrated, and scientific and concise in its presentation. It is therefore recommended as a valuable book for every physician, medical student, and technician interested in light therapy. JOHN S. COULTER.

THIS second, revised edition of Buckstein's contribution to the *Annals of Roentgenology*[3] contains much of the same material found in the first edition,

[1] TEN YEARS OF OBSTETRICS AND GYNECOLOGY IN PRIVATE PRACTICE; A CLINICAL REPORT OF 1750 OBSTETRICAL AND 1345 GYNECOLOGICAL CASES, WITH COMPARATIVE ANALYSES OF MANY OF THE LARGER GROUPS, AND DETAILED CASE HISTORIES OF SOME OF THE MORE IMPORTANT AND LESS COMMON CONDITIONS. By John L. Rothrock, A.B., M.D., F.A.C.S. New York: Paul B. Hoeber, Inc., 1933.

[2] LIGHT THERAPY. By Frank Hammond Krusen, M.D. Foreword by John A. Kolmer, M.D., Dr.P.H., D.Sc., LL.D. New York: Paul B. Hoeber Inc., 1933.

[3] ANNALS OF ROENTGENOLOGY; A SERIES OF MONOGRAPHIC ATLASES. Edited by James T. Case, M.D. VOL. X, PEPTIC ULCER. By Jacob Buckstein, M.D. 2d ed. rev. New York: Paul B. Hoeber, Inc., 1933.

with the addition of many new things of great value. The roentgenograms show gastric and duodenal lesions of all types and in almost all stages of development and regression. The effect of treatment and the recession of the ulcer, when it responds to treatment, are well shown. The great value of mucous membrane studies and their relation to ulcers of the duodenum and posterior wall of the stomach is stressed.

In the opinion of the reviewer, however, while the didactic matter is up to date and shows that the author is cognizant of the recent literature, it is so sketchy that, in a book of this size, it should have been either amplified or dropped entirely. The descriptions of the plates are too brief to be of value to the inexperienced and to the experienced interpreter of roentgenograms the films are of such dubious quality that one must of necessity be well versed in the study of roentgenograms to interpret them. It is difficult to understand why all the illustrations are direct prints from X-ray films, thus giving color contrasts opposite to that viewed by the radiologist on the ground glass screen.

The discussion of mucous membrane relief studies is of considerable interest and the illustrations merit favorable comment. The second edition elaborates somewhat on this type of examination and the pathological anatomy of the mucous membrane.

Finally, it seems to me that the book is entirely too large for the matter contained; I believe it could be cut down to two-thirds its present size without detracting from the value. This probably would be reflected in a lowered cost.

ROBERT A. ARENS.

VOLUME VII which is a supplement to the *System of Operative Surgery*[1] by Bickham appears now, approximately 8 years after the publication of the original work. In this volume which is prepared by Smyth, the author endeavors "to bring up-to-date the previous six volumes by the addition to each section of those operative procedures which have become established as a part of the armamentarium of the well equipped surgeon."

After a rather fruitless attempt to extol the art and science of surgery, the author describes operations which he believes should be included in a complete system of operative surgery and which are not to be found in the six volumes originally published. The author makes no claim for originality of the operations and in practically every instance quotes extensively from, and gives credit to, the originator of the technique discussed. The chapters dealing with operations upon the chest and the colon contain the greatest amount of new material, since it is the author's belief that in these fields the greatest number of new operations has been developed in recent years.

[1] OPERATIVE SURGERY; THE OPERATIVE TECHNIC INVOLVED IN THE OPERATIONS OF GENERAL AND SPECIAL SURGERY. By Warren Stone Bickham, M.D., Phar.M.(Tulane), M.D.(Columbia), F.A.C.S., and Calvin Mason Smyth, Jr., B.S., M.D., F.A.C.S. Vol. vii. Philadelphia and London: W. B. Saunders Company, 1933.

The volume is replete with excellent illustrations depicting operative technique and as a whole the material is well assembled, yet this work seems to lack the scientific and classic flavor of the previous volumes. The text is at times misleading and difficult to construe. An exception must be taken to the statement on page 81 relative to precautions to be observed in using spinal anæsthesia. The author states that "If the systolic pressure drops to 30 mm. Hg., give an intravenous injection of warm physiologic salt solution or Ringer's solution, and if the pressure continues to drop, epinephrine should be added in sufficient amount to bring the systolic pressure to 40 . . . ." Such advice if taken literally would lead to frequent disasters. On page 240 the author states that in draining the floor of the mouth an incision is made "between the hyoid bone and the thyroid cartilage"—obviously an error; also that a hæmostat when passed into the incision will appear between the teeth. Attention is called to these items in an effort to give a constructive criticism of the work since it is obvious that a tremendous amount of energy has been expended in the preparation of the volume. The author has attempted to place in the hands of the reader a ready means to familiarize himself with a countless number of established operative procedures but the reader at times is handicapped in that statements are sometimes involved and a few errors have crept in.

JOHN A. WOLFER.

THE announcement of a work upon the treatment of squint from one of the English clinics where so much interesting work has recently been done was received in this country with the highest expectations. Miss Dobson's little book[2] fails to live up to these in many respects. The chapters on binocular vision and binocular balance are necessarily short and offer nothing new, but contain a useful résumé of some practical tests. The author emphasizes the suspension of vision as a cause of squint and discusses the importance of its recognition and treatment by orthoptic training at the earliest possible moment. Miss Dobson believes that while amblyopia may be congenital, in which case treatment is of no effect, amblyopia from disease does often occur and is susceptible of great improvement by treatment. Besides the usual measures, the use of monocular stimulation by moving objects with an American instrument, the myoculator, and with the author's rotating disc is advised. It is interesting that Miss Dobson employed a modern form of the "squint mask" illustrated in the oldest texts. Rubber discs are worn, provided with holes which limit the field of the fixing eye and admit light to the amblyopic eye at a point away from the amblyopic area in which vision is suspended. The stimulation of these seeing areas develops vision and causes the position of the eye to improve

[2] BINOCULAR VISION AND THE MODERN TREATMENT OF SQUINT. By Margaret Dobson, M.D.(Lond.). London: Oxford University Press, 1933.

markedly, she claims. Other devices making use of the same principle are employed with much ingenuity.

One is surprised to find a discussion of refraction in this book, and is more surprised that the author is a warm advocate of "dynamic refraction," giving atropine, apparently, in very few cases. Few ophthalmologists will agree that all the latent hyperopia can be elicited by this means, or that correcting only a portion of this will make the fullest possible use of refraction in correcting convergent squint.

The discussion of orthoptic training comprises 40 pages and consists chiefly in a description of various ingenious instruments which have recently been devised by Maddox and other English workers. Most important of these are the synoptiscope and the author's binocularscope.

Your reviewer believes that Miss Dobson is right in stressing the importance of orthoptic training in most cases of squint and that such training is equally important after operation where this becomes necessary. What she fails to do, however, is to prove her thesis by illustrative cases or by statistics of results in a group of cases. She is content with general statements that this or that procedure will cure many cases of squint or improve amblyopia. No statistics of other workers are quoted and her bibliography consists in large part of references to the announcements of instrument-makers. Works by a "Dr. Peckham" of Waterbury, Connecticut, who would seem to be an optometrist, are quoted with respect.

Miss Dobson apparently fails to realize that many excellent ophthalmologists have been discouraged in the use of orthoptic training by their own experience or by the reports of others, and that a great deal of real evidence is required to convince them of its importance. SANFORD R. GIFFORD.

THE monograph on the combined procedures of arteriography and encephalography[1] by Loehr and Jacobi is published as a supplementary volume to Grashey's work on roentgen-rays.

In it the authors present a review of the literature on encephalography and in more detail the literature on arteriography. A chapter is devoted to the development and usage of thorotrast as a contrast medium. They present fully their technique of cerebral arteriography which in their hands has been marked with exceptionally few hazards of deleterious effects. The contra-indications are the same as for encephalography alone.

The topographical anatomy of the normal cerebral vessels as shown by arteriography with thorotrast is given and a case of deviation from the normal (hæmangioma of the face and brain) is shown in contrast. Descriptions are given of the findings by the combined procedures in cases of taboparesis, epilepsy, arteriosclerosis, hydrocephalus, and cerebral tumor. A considerable portion of the clinical part of the work is devoted to a rather complete atlas of X-rays of the procedure in cases of tumor.

HALE HAVEN.

[1] FORTSCHRITTE AUF DEM GEBIETE DER ROENTGENSTRAHLEN. Edited by Prof. Dr. Grashey. Vol. xliv, DIE KOMBINIERTE ENZEPHAL-ARTERIOGRAPHIE. By Prof. Dr. W. Loehr and Prof. Dr. W. Jacobi. Leipzig: George Thieme, 1933.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

NEUE DEUTSCHE CHIRURGIE. Established by P. von Bruns. Edited by Erich Lexer. Vol. lv. DIE LUFT- UND FETTEMBOLIE. By Dr. med. Siegfried Hoffheinz. Stuttgart: Ferdinand Enke, 1933.

ATLAS OF PATHOLOGICAL ANATOMY. Issued under the direction of the Editorial Committee of the British Journal of Surgery. Compiled by E. K. Martin, M.S., F.R.C.S. Vol. i. Baltimore: William Wood and Company, 1933.

THE TEACHING OF PREVENTIVE MEDICINE IN EUROPE. By Carl Prausnitz, M.D. (Breslau), M.R.C.S. (Eng.), L.R.C.P. (Lond.) London: Oxford University Press, 1933.

BENIGN TUMORS IN THE THIRD VENTRICLE OF THE BRAIN: DIAGNOSIS AND TREATMENT. By Walter E. Dandy M.D. Springfield, Illinois, and Baltimore, Maryland: Charles C. Thomas, 1933.

DE VENARUM OSTIOLIS 1603 OF HIERONYMUS FABRICUS OF AQUAPENDENTE (1533?–1619). By K. J. Franklin, D.M. Springfield, Illinois, and Baltimore, Maryland: Charles C. Thomas, 1933.

AMERICA SELF-CONTAINED. By Samuel Crowther. Garden City, New York: Doubleday, Doran & Company, Inc., 1933.

WILHELM CONRAD ROENTGEN AND THE EARLY HISTORY OF THE ROENTGEN RAYS. By Otto Glasser. With a Chapter "Personal Reminiscences of W. C. Roentgen" by Margret Boveri. Springfield, Illinois and Baltimore, Maryland: Charles C. Thomas, 1934.

AMERICAN COLLEGE OF SURGEONS

THE ORGANIZATION OF A TUMOR CLINIC IN A GENERAL HOSPITAL[1]

GEORGE T. PACK, M.D., NEW YORK
The Memorial Hospital, New York City

THE neoplastic diseases have not had deserved attention in this age of medical specialization. Hospitals especially equipped for the treatment of tuberculosis, affections of the eye, bones and joints, maladies peculiar to women and children, and communicable diseases have been established throughout the country. Yet most cancers are treated in ambulatory patients by general practitioners and in the wards of general hospitals. A disease which is inevitably fatal if untreated, should receive the best possible advantages of care by physicians skilled in its diagnosis and treatment. To attain this end, these patients should be segregated in separate wards and clinics, under the management of physicians well trained in this work. It is our belief that this problem can be best solved by the establishment of tumor clinics in general hospitals.

This statement seems to be substantiated by the rapid increase in the number of tumor clinics in general hospitals during the last decade. Dr. Cox, of the American Society for the Control of Cancer, states that in 1920 there were approximately fourteen such clinics in the United States. In the February, 1932 issue of SURGERY, GYNECOLOGY AND OBSTETRICS, a report was made by Dr. Greenough, then chairman of the Committee on the Treatment of Malignant Diseases, to the effect that the American College of Surgeons had approved 100 cancer clinics, recommended for approval 58 cancer clinics, and that 185 clinics were in the process of organization.

The committee of the American College of Surgeons on the Treatment of Malignant Diseases has classified the special facilities for the treatment of neoplastic diseases into four groups, as follows: (1) cancer institutes; (2) cancer research laboratories; (3) cancer hospitals; (4) cancer clinics in general hospitals.

The cancer institute is the ideal solution as it includes a hospital organized and maintained solely for the diagnosis and treatment of cancer, as well as adequate research laboratories manned by a staff of pathologists, physicists, chemists, and bacteriologists. Such cancer institutes which unfortunately are few in number include the Huntington Memorial Hospital in Boston, the New York State Institute for the Study of Malignant Disease in Buffalo, the Cancer Institute of the City of New York, and the Memorial Hospital in New York City.

It is not feasible to care for all cancer patients in cancer institutes or cancer hospitals because these institutions must be situated in centers of large population. Geographical distances are too great in the United States to enable the transportation of cancer patients to and from these centers as is the practice in Sweden and France. It is obvious that for economic and social reasons, the needs of the average community are best met by the cancer clinic in a general hospital. Since only a relatively small number of patients suffering with cancer can be treated in cancer institutes and cancer hospitals, the general hospitals throughout the country have the serious responsibility of caring for the greater proportion of cancer cases. Burton J. Lee has said: "An inspection of almost any large general hospital in the United States or Canada will disclose cancer patients indiscriminately scattered throughout the services of the hospital, some under the care of the surgeon, others in a general medical ward, pediatric or orthopedic ward, and not a few under the care of the roentgenologist or radiologist. Cancer is a major health problem which must be intelligently met by the boards of managers and medical staffs of the large general hospitals in this country. No such hospital today can be considered fully efficient unless a well organized cancer service exists within its doors."

The tumor clinic may well be organized according to the recommendations of the Committee on the Treatment of Malignant Diseases of the American College of Surgeons in their brochure "The Organization of Service for the Diagnosis and Treatment of Cancer. A Minimum Standard."

The department had better be known as a tumor clinic rather than as a cancer clinic, because many patients do not wish to be seen in an in-

[1]The model clinic, of which this article is written, is the Josephine Lendrim Tumor Clinic of the Paterson General Hospital, Paterson, New Jersey.

stitution labeled as a cancer hospital. The word "cancer" should not be employed in contacts with patients, even though a tacit understanding exists as to the nature of the disease being treated.

There are certain mutual advantages in the utilization of the personnel and physical equipment of already existing hospitals for the organization of a tumor clinic, because these constitute established centers in which modern diagnostic and therapeutic procedures can be conducted. These hospitals have the personnel and equipment for this service, and are only lacking in a definite organization together with sufficient radium, a high voltage X-ray machine and a radium therapist necessary to attain this objective. Approved general hospitals have already established their reputation in the community and the tumor clinic will benefit by this credit. The affiliation of the tumor clinic with the general hospital is the most economical arrangement possible, as it enjoys the advantages of clinic quarters, hospital beds, interne and nursing staff.

The establishment of such a clinic in a general hospital offers many advantages to the patient with cancer. First, the diagnosis of the disease is made accurately and promptly. Treatment of the cancer is instituted without delay. Precancerous lesions are recognized and removed. No one physician has sufficient knowledge and experience in the treatment of neoplastic diseases of all organs to be independent of the opinions and aids of his medical confrères. Group judgments as to diagnoses and proposed plans of treatment are preferable as they are based on the agreements of surgeon, radiologist, pathologist, etc. The patient benefits by the knowledge, skill, and experience of physicians who have devoted themselves to the diagnosis and treatment of this disease. Furthermore, the cancer clinic is equipped with special diagnostic and therapeutic facilities as well as a supply of radium which independent physicians can seldom afford. Another important service is daily nursing care for ambulatory patients at a minimal cost.

After the establishment of a tumor clinic in a community, it will be observed that the delay between the onset of symptoms and the appearance of the patient in the clinic will noticeably decrease year by year. Early submission for diagnosis results in a higher percentage of cancer cures. This increase in the relative percentage of cases classified as early or operable may be attributed to the educational activities of the clinic, the awakening of public and personal interest in cancer prevention and treatment, the missionary efforts of patients who have been satisfactorily treated, and the co-operation of the physicians in the community.

Advanced inoperable cases are usually treated by radium or X-rays which are held in scepticism by some patients and considered as infallible curative measures by others. On this account, the prognosis should be explained to the relatives in the case of every advanced cancer accepted for treatment by the clinic, as well as the degree of palliation defined and these facts reiterated at succeeding visits so that the relatives will not be too optimistic during the palliative stage. All cancers are not curable and the services of the clinic are not limited to early or operable cases. Occasional cures are unexpectedly obtained in certain apparently hopeless cancers. It is the function of the clinic to offer palliative treatment, if possible, to all the unfortunate patients who fall in this category. In discussing this point, Robert Greenough said: "I believe that the palliative treatment given to advanced cases is often one of the ways in which the clinic establishes its efficiency in the minds of the physicians of the community."

The number of cancer clinics in any community depends largely on local needs and existing hospital facilities. This is a problem which cannot be decided by rule of thumb or gross population. There can never be too many diagnostic tumor clinics in any city, but for cancer therapy it is more ideal and less expensive to have properly located treatment centers with adequate radium and X-ray facilities.

The tumor clinic in the general hospital should be autonomous. It should receive for treatment not only the patients with advanced incurable cancers referred to it from the surgical service and other departments in the hospital, but should be privileged at least to see in consultation or to outline the treatment of every patient with a benign or malignant tumor. Although all members of the hospital staff recognize the great need and value of a cancer clinic in a general hospital, yet a few individual members at first may be unco-operative. This attitude is most frequently encountered in surgeons who will not always relinquish with good grace the opportunities of operating upon so called operable cancers of the cervix, tongue, or lip and object to the transfer of these patients to the tumor clinic where they may be treated with radiation therapy instead. Surgeons should realize that the vast majority of cancers are best treated by surgery alone or in combination with radiation therapy; radium is an adjunct to surgery and often requires surgical exposures for its accurate application. The surgeon, therefore, must

play a very important rôle in the conduct of the clinic. Very few surgeons have a good foundation in or knowledge of radiation therapy nor are they sufficiently versed to know the relative values of surgery and irradiation in all varieties of cancer. It is for this reason that the patients should be first seen in the tumor clinic where their treatment is outlined. The tumor clinic in some hospitals merely serves as a medium for consultations and follow-up observations. Its services under this arrangement are optional and not obligatory. However, any clinic so established will prove its worth in time and later be given more authority in the disposition of cancer cases. In the tumor clinics in general hospitals where consultation is voluntary rather than obligatory the surgeon who does not avail himself of the opportunity so afforded will soon be criticized because of the inevitable mistakes made in the diagnosis and methods of treatment.

All cancer patients discharged from the wards of the hospital are referred to the tumor clinic for follow-up observations. There can be no serious objection to this plan inasmuch as the other hospital services are seldom as interested, conscientious, and competent in the after-care of patients treated for cancer. The follow-up visits on patients treated for cancer extend indefinitely, as long as the patient lives. These visits should be made at frequent intervals during the first 5 years and after this at intervals of 6 months to 1 year for the remainder of life. Only by such observations at intervals can the percentage of so called cures of cancer be determined for definite periods of survival.

The tumor clinic should afford arrangements in the out-patient department for the daily care of ambulatory patients undergoing radium therapy. This clinic frequently referred to as the "clean-up" clinic is under the management of a well trained nurse assigned to the cancer unit or in some instances to a junior attending surgeon. The skin reactions following radiation therapy of cancer of the breast, neck, or mouth are often intense and attended by blistering and desquamation of the skin causing the necessity for frequent or daily dressings. Patients under treatment for cancer of the mouth require frequent intra-oral irrigations and skilled cleansing of the mouth and of the cancer. This very important service greatly relieves pain and discomfort, lessens the danger of complicating infection, establishes adequate drainage for cavities (e.g., the paranasal sinuses), stimulates the production of granulation tissue in the healing of the wound, and invariably hastens the rapid recovery of the patient.

The establishment of the tumor clinic will reduce materially the amount of bed care in the hospital because many of the patients seen in the cancer clinic are ambulatory during the greater part of their treatments, whereas previously many of them were admitted to the hospital for the entire time. The tumor clinic therefore enables the general hospital to discharge its obligations to cancer patients by more accurate and scientific treatment given at less cost to the institution.

The expenses of the cancer clinic may be partially defrayed by charging those patients who are able to pay a small registration fee on application. There should also be a sliding scale of prices for radium and X-ray treatments according to the financial classification of the patient. When the radium is used in the treatment of private patients, the rental fee is accredited to the income of the cancer clinic. A small fee of 10 to 25 cents may be charged for follow-up visits but this is not stressed too much, otherwise it may discourage these very important visits.

The staff of the tumor clinic should consist of an internist, gynecologist, urologist, dermatologist, rhinolaryngologist, proctologist, pathologist, roentgenologist, general surgeons and consultants, together with specially trained nurses, radium technicians, and secretaries.

The director of the tumor clinic should be well qualified by experience and personal interest in the cancer problem and should be preferably on a full time basis. He may be either a pathologist, radiologist, internist, or surgeon, although as the treatment of cancer is largely a surgical problem, the surgeon generally exercises administrative control of the clinic.

The work in a cancer clinic is subdivided and planned so that cancers of the skin are assigned to the dermatologist, cancers of the ovary, uterus, vagina, and vulva to the gynecologist; cancers of the urinary bladder, prostate, testis, kidney, penis, and urethra to the genito-urinary surgeon; and cancers of the larynx, pharynx, nose and mouth to the intra-oral surgeon and otolaryngologist. The surgeons in attendance to the clinic may have particular interests in the diagnosis and treatment of cancers of different organs. For example, tumors of the breast may be assigned to one surgeon who by experience or preference justifies this selection; similar assignments are given for bone tumors, cancers of the œsophagus and stomach and for cancers of the colon and rectum.

The efficiency of the clinic improves as these various surgeons acquire particular skill in the surgical and radiological management of tumors in these locations. A consulting dentist is of in-

valuable assistance in the construction of protective dentures for use during the radium treatment of intra-oral cancers and in reconstructive facial surgery.

The internist serves a most important function in the clinic. To him are assigned the diagnosis and treatment of various medical complications that may occur, the various blood diseases such as the leukæmias, anæmia, polycythæmia, also the diagnosis and treatment of the tumors of the lymphoid system such as lymphosarcomata, Hodgkin's disease, and others. He may also take special interest in the diagnosis and treatment of mediastinal tumors and of carcinoma of the lung. All the efforts at constitutional therapy of cancer and the dietary management of this disease should be assigned to this department.

The pathologist, who is an integral part of the clinic, should be well trained in the gross and microscopical diagnosis of neoplastic diseases. Another essential in his training and experience is the ability to grade histologically the various carcinomata studied and to judge their radiosensitivities. He should be adept in frozen section diagnosis and should also be familiar with the rapid preparation of tissues obtained through needle puncture (aspiration) and the various methods of punch biopsy. An attempt should be made to obtain a necropsy on every patient who dies of cancer.

The pathological museum should contain every gross specimen of cancer removed by surgical extirpation and at autopsy. The microscopic slides of every tumor and of every biopsy should also be on file; these should be preserved permanently and catalogued with cross indices so that this material is readily available for study or analysis whenever a special review of this subject is contemplated.

The educational advantages of the clinic are enjoyed by the internes on a rotating service who should be assigned for an aliquot part of their time in the out-patient department to the cancer clinic. It is their privilege to examine patients in the clinic and to follow their subsequent management including X-ray, radium, and surgical treatments. The interne is of considerable assistance in the tumor clinic by taking histories, making general physical examinations, and by his observations and attendance in the follow-up clinics.

The nursing personnel is of great importance. The nurse or nurses assigned to the clinic are considered as permanent members of the organization. With this status they become acquainted with the necessary technical details in the treatment of ambulatory patients by radium and X-rays; they become familiar with and adept in the preparation of radium applicators; they acquire skill in dressing cancer patients and they are of an especially helpful assistance in certain diagnostic procedures such as œsophagoscopy, gastroscopy, bronchoscopy, etc. They also learn the modalities for the use of the endotherm knife or surgical diathermy.

The tumor clinic should be provided with a full time, competent medical secretary who is thoroughly acquainted with the methods of history taking, recording, filing, analyzing end-results, cross indexing and recording doses of radium and X-rays.

The records used in the cancer clinic contain complete data on the history, physical examination, laboratory findings, diagnosis, treatment, and follow-up notes of patients with all varieties of cancer. For completeness, uniformity, and simplicity, it is suggested that these records conform to the system approved by the Committee on the Treatment of Malignant Diseases of the American College of Surgeons. The patients are given a clinic number on application. The case histories are filed and cross-indexed, therefore they may be located in yearly groups, under the patient's name or according to the final diagnosis.

The social importance of the cancer problem must be recognized and the co-operation of the social service department of the hospital obtained. Where this service is lacking, the follow-up of cases is performed by other agencies, such as the community health center or the personal efforts of the permanent secretary to the tumor clinic. The social service worker is especially fitted to evaluate the social and economic status of the patient. She ascertains if the patient can support his family while under cancer treatment and arranges for the temporary care of minor children. The financing and rehabilitation of the patient after treatment and while convalescing may require community aid, which the social service worker provides by mobilizing the resources of the community. The return visits of the patient to the tumor clinic for further treatments and follow-up observations are insured by this supervision. Other invaluable services rendered to the patient in his home are proper postoperative and postirradiation management, instruction in the hygienic care of this disease (diet for gastric cancer, hygiene of oral cancer, etc.), and nursing aid to the incurable patient during the terminal period of his disease.

The radiologist or radium technician, who assembles the radium in the different applicators or collects and measures radon, should be fully

protected against the injurious effect of β- and γ-rays. This protection is afforded by several devices kept in the radium assembly room, for example: (a) the radium itself is stored in a thick walled lead box within a safe; (b) the radium is transported to other parts of the hospital in a heavy metal conveyor or box with a long handle, so that the radium is near the floor and as distant as possible from the body, or it is wheeled in a small carriage; (c) lead hand shields are built around the handles of the assembly forceps, so that the worker's fingers are not subjected to undue irradiation; (d) the radiologist, technician, or nurse stands behind a thick upright lead shield with lead glass top while assembling the various applicators.

The radium is kept in a safe, the combination of which is known only to one or two members of the cancer staff preferably the roentgenologist, who is on a full time basis. The safe in this model clinic is built in the same closet with the case records, all of which can be locked again by an outside door. The loan of the radium to the attending staff is done through this caretaker, who assumes the sole responsibility for its return. The applications for the use of the radium are filed in chronological order so that no preference is ever shown in its dispensation.

In addition to facilities for X-ray diagnosis, it is essential that the department of radiotherapy be supplied with a high voltage X-ray machine of sufficient voltage to insure effective external irradiation. The Committee of the American College of Surgeons on the Treatment of Malignant Diseases states that such an X-ray therapeutic unit should have a peak strength of 200,000 volts. This is the standard voltage for most high voltage therapeutic X-ray machines in use in the United States today. The machine may be air cooled, or water cooled at 20 to 30 milliamperes; the latter set-up is more economical and time saving, particularly when there are many patients to be treated.

The working unit in the tumor clinic should be confined, as far as possible, to one wing of the hospital. In addition to three separate waiting rooms, there should be a general office and a separate record room. A large room containing cubicles with examination tables and dental chairs suitable for ear, nose, and throat examinations and treatments is a necessity. The customary scrubbing sink, small electric sterilizer, instrument cabinets, and dressing carriages are also placed in this treatment room; especially useful is a light mobile dressing carriage on which may be assembled the instruments necessary for œsophagoscopy, bronchoscopy, surgical endothermy, etc. There is a separate room in this particular clinic for gynecological examinations, an additional room with a cystoscopic table for genito-urinary examinations, two rooms for X-ray diagnosis and fluoroscopy, the rooms housing the high voltage X-ray machine, and a separate small waiting room for this unit. A large closet is painted entirely black to serve as a dark room for transilluminations of the breast and oral cavity. This wing of the hospital is situated on the ground floor and has a separate entrance from the street.

There should not be just the one waiting room for all patients coming to the cancer clinic. At least three small waiting or reception rooms are desirable: one for new patients, another for patients in the advanced stages of the disease, and a third one for patients who are under treatment and exhibiting the recent effects of radiation therapy or surgery. Some of these effects are quite disturbing to the patient who anticipates such treatment. If the clinic meets officially twice a week, it is well to have women come on one day and men on another in order to avoid possible embarrassment as well as to remove every obstacle in securing ready access to the clinic and its facilities.

There should be on file in the hospital library about fifty of the modern monographs on tumors, radium therapy, and X-ray treatment. It should also subscribe to: the *American Journal of Cancer*, *Radiology*—the official organ of the North American Radiological Society; the *American Journal of Roentgenology and Radium Therapy*—the official organ of the American Roentgen Ray Society and the American Radium Society; SURGERY, GYNECOLOGY AND OBSTETRICS (with INTERNATIONAL ABSTRACT OF SURGERY)—the official journal of the American College of Surgeons; and the *Year Book in Radiology*. Practically all worthwhile articles on neoplastic diseases either are published in these journals or are reviewed in their abstract sections.

The personnel of the tumor clinic, the character of the work done, the facilities for consultation and diagnosis, the hours for conductance of the clinic, and the equipment and possibilities for proper cancer therapy must be well known to every physician in the immediate vicinity of the hospital. This is important because approximately four-fifths (80 per cent) of all patients cared for in the tumor clinic of general hospitals have been referred by doctors and only one-fifth of the total cases have never previously seen a physician. Dentists should be similarly informed; the director of the clinic should arrange for appropriate demonstrations and lectures before the local dental

society in the hope of stimulating interest in the early recognition of intra-oral cancer.

The tumor clinic assumes certain educational responsibilities to the physicians of the community as well as to the laity. The centralization or grouping of all the cancer cases in the city enables each physician to see and examine his colleague's cases, thereby greatly increasing his experience and familiarity with the various neoplastic diseases. The clinic staff should encourage all physicians to attend the clinics and weekly conferences by a hospitable welcome and a cordial willingness to demonstrate and discuss the cases under observation. A formal educational program consisting of an annual lecture series with out-of-town speakers, thoroughly experienced in the diagnosis and treatment of cancer, may be arranged with the co-operation of the county medical society or academy of medicine. Information concerning the early signs and symptoms of cancer and the prevention of this disease is dispensed by addresses to women's clubs, luncheon clubs, lodge assemblies, and church societies. Informal afternoon addresses open to the public are given by prominent cancer specialists, who are scheduled on the same date for the evening programs of the medical society. It is well to have the tumor clinic closely allied with the local branch of the American Society for the Control of Cancer. The potential effectiveness of a local branch of this society, when properly organized and directed with definite objectives, can be illustrated best by the phenomenal success of the Westchester (N. Y.) County Cancer Committee, under the able guidance of Dr. H. R. Charlton. This cancer committee, a unit of the American Society for the Control of Cancer, is responsible for the best organized and model cancer service in any community in the United States. The experience and support of this national society is an invaluable ally to any new tumor clinic.

A clinicopathological conference every week or two may be arranged for attendance by physicians. It is known as the cancer conference and is conducted by the director of the tumor clinic. The conference is held promptly at a time suitable for the majority of the physicians in the hospital. The program should be prearranged in order to enable physicians who are participating to abstract the case histories and prepare their material for presentation. At such conferences rare and interesting cases are presented as well as tumors presenting difficult problems in clinical or microscopical diagnosis. Other patients are shown and their diagnosis and treatment discussed in order that they may profit by expert group opinion. These opinions are duly recorded so that when these same patients are presented at some later date, the conference may judge for itself the advantages or disadvantages of the method of treatment selected. Stenographic notes of the discussion of all cases are kept and these notes incorporated on the patient's chart together with the tentative diagnoses, names of physicians making the diagnoses, and suggested methods of treatment.

The conference room is well selected and arranged in order that the patient may be easily visible to all the physicians in attendance. The patient is placed on a platform slightly higher than the level of the floor. Illuminated boxes for viewing X-ray films are properly situated. One or two separate dressing booths adjacent to the conference room are helpful in case the consultants find it necessary to make certain examinations (gynecological, rectal, etc.) in private. The conference room is also equipped with a blackboard, a screen and a projectoscope for viewing lantern slides. The case presentations are made by the men most interested; they should be concise and pertinent.

The method of presentation is to give a brief history of the illness and then recite the physical findings and whatever special laboratory tests and diagnostic procedures have been carried out. A few qualified physicians, but not all of the members in attendance, are called upon to examine the patient in order that they may discuss the case later. Finally, the patient is permitted to leave the conference room before the diagnosis is mentioned and before the discussion concerning the treatment is begun. The diagnosis and the proposals concerning treatment must never be mentioned in the presence of the patient.

Innovations in diagnostic procedures and new departures in treatment are discussed and illustrated by case presentations. The weekly cancer conference also affords opportunities for special or preliminary reports on cancer research in progress or reviews of recent literature concerning certain tumors. At a stated time yearly the conference reviews the 3 and 5 year end-results in terms of cures or survivals for this time without evidence of recurrence.

At each conference the pathologist may present interesting surgical or postmortem specimens both in the gross and under the microscope and associate these lesions with a brief review of the case history and clinical findings. A microscope should be so arranged that all members of the clinic may have the opportunity of studying the microscopic structure of those tumors under the tutelage of the pathologist. The members of the cancer conference thus may become acquainted with the nat-

ural history of the disease and are enabled to correlate the clinical appearance, microscopic and gross pathology, and the radiosensitivity of the tumor under consideration.

SUMMARY

A properly organized tumor clinic in a general hospital with suitable equipment and trained personnel is the most feasible plan for the diagnosis and treatment of cancer in a city of moderate size.

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PARATHYROID TUMORS ASSOCIATED WITH HYPERPARATHYROIDISM

ELEVEN CASES TREATED BY OPERATION

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BUT a short time ago the parathyroid bodies were charted only as dangerous ledges to be avoided during the surgical removal of the thyroid; now they have been carefully surveyed and are regular ports of call for the surgical navigator. As is apt to be the fate of newly discovered territory, a halo of legend and romance surrounds them and the danger of over exploitation at the hands of traders and buccaneers is real. Even master mariners are apt to be deceived when an unexpected landfall is made and the fountain of eternal youth appears through the mist.

The development of the surgery of the parathyroid bodies is closely linked with the development of knowledge concerning adenomata of the glands of internal secretion. It runs parallel with exploits of surgery in the case of tumors of the islet tissue of the pancreas, and the recognition of the basophilic adenoma of the pituitary body. The diameter of these adenomata of the endocrine glands may be measured in a few millimeters, yet the associated constitutional disturbance frequently alters the entire aspect of the body or leads to its total destruction.

The diagnosis of hyperparathyroidism is one of the most spectacular and notable achievements of the laboratories of experimental medicine.[1] Following closely upon the heels of the isolation of the internal secretion of the parathyroids—parathormone, experimental studies, both on animals and man, demonstrated the profound disturbance in metabolism that attends its introduction into the body in abnormally large amounts. These same disturbances follow an overproduction of parathormone by abnormal parathyroid tissue. In primary hyperparathyroidism this tissue is found as a tumor-like enlargement of one or more of the parathyroid bodies. Such a tumor is termed an adenoma although its relationship to the true neoplasms is not as yet clearly defined.

Hyperparathyroidism is characterized by certain definite alterations in the metabolism of calcium and phosphorus (3). The body loses its ability to retain these elements in the

[1]The authors acknowledge with gratitude their close association with a distinguished group of medical colleagues that has made important contributions in the field of inorganic salt metabolism over a period of years. Our own knowledge of hyperparathyroidism is largely drawn from their work and the cases that form the background for this paper were assembled as a result of their diagnostic studies. We extend our compliments particularly to Dr. Joseph C. Aub, Dr. Walter Bauer, and Dr. Fuller Albright. Our relationship with these colleagues has in addition given us a wholesome respect for the laborious efforts and extreme accuracy that must underlie studies on calcium and phosphorus metabolism. A team of trained workers has been deployed from the hospital kitchen and the bedside of the patient to the laboratory bench. The patients have almost without exception been interested and co-operative even in the face of countless venepunctures, dietary experiments, and repeated operations. If in the course of this paper the authors appear unduly critical of the efforts of others, such contributions are not being judged by the measure of any work we can call our own. It has been our good fortune to have had expert guidance in a new and complex subject.

natural tissue reservoirs for their deposit—chiefly, the bones. A high tide of calcium in the blood is manifested by an elevated serum calcium and an increased excretion of calcium in the urine. At the same time there is an increased urinary excretion of phosphorus in spite of a decreased serum phosphorus. The amount of calcium and phosphorus excreted in the fæces is usually within normal limits.[1]

The changes in blood calcium and blood phosphorus levels are significant and for practical clinical purposes are of diagnostic import.[2] As Aub points out, however, determination of the blood concentration of an inorganic salt gives no indication of the rate of flow or its direction, whether into excretory channels on the one hand, or into the tissues on the other. *An excessive excretion of both calcium and phosphorus determined by metabolic studies with the patient on a test diet* constitutes the basic disturbance.

The concentration of phosphatase in the plasma is elevated in hyperparathyroidism. Phosphatase is an enzyme that plays a specific rôle in the deposition and maintenance of calcium and phosphorus in the tissues (17). An increased plasma concentration is by no means a diagnostic finding as it occurs in several diseases where there is abnormal destruction or formation of bone tissue. Taken in conjunction with metabolic studies the determination of phosphatase is of value.

The chemical determinations in hyperparathyroidism are summarized in Table I and contrasted with those of certain other diseases in which disturbances of calcium and phosphorus metabolism are known to exist or have been postulated.

The inability of the bones to retain calcium provides the outstanding clinical manifestation of hyperparathyroidism—a generalized decalcification of the skeleton. The changes in the bones are so striking in an advanced case that the disease has been called "osteitis fibrosa cystica generalisata."[3] Advance in knowledge has proved this nomenclature unfortunate in more than one respect. First, it focuses the attention on merely one aspect of the morbid anatomy of the disease; indeed, the skeletal changes may be entirely lacking in certain cases. In addition, the name emphasizes the changes that are characteristic only of the end stages of bone destruction. The formation of cysts and brown tumors in the bones appears as a late result of the decalcification and destruction of the bones by osteoclasts. As the normal architecture of the bone is destroyed, fibrous tissue replaces the normal bone marrow. *Osteodystrophia fibrosa*, a term now used by German pathologists more aptly describes the skeletal changes of hyperparathyroidism, as it indicates the initial pathological process. It is to be borne in mind, however, that changes in the bones constitute only one of many manifestations of the disease and may be unrecognizable except by biopsy in an early case.

The increased excretion of calcium and phosphorus in the urine provides a sequence of events that may be fully as characteristic as the skeletal changes. A progressive calcification of the cortex of the kidney may become so marked that it is demonstrable by X-ray films (Fig. 1) and indeed, proved the clue that led to the diagnosis in Case 9 of our series. Calculi may form in the pelvis of the kidney on one or both sides. Symptoms referable to renal or ureteral stone may be the first clinical manifestation of the disease (Case 5), a fact that should be kept in mind by urologists.

In addition to, and possibly independent of, the calcification of the renal cortex and the formation of stones comes a progressive impairment of renal function with the urinary findings of nephritis. Extensive kidney damage may in turn prove a barrier to the further excretion of large amounts of calcium in the urine, and as the urinary excretion of calcium falls to normal the output in the fæces, which is at first unaffected, may rise. Such a state

[1] In Case 3 in the face of extreme kidney damage the fæcal calcium was definitely increased and the urinary calcium within normal limits.

[2] As far as practical clinical diagnosis is concerned, it must be recognized that very few clinics are equipped to carry on complete calcium and phosphorus metabolism studies. We do not insist that they are necessary in the cases with a classical train of symptoms and typical X-ray findings. In questionable cases, however, and particularly in the extension of operations on the parathyroids to diseases other than osteitis fibrosa cystica, it is obvious that the best interests of the patient demand careful and scientifically controlled studies. It is also well to remember that the quantitative determinations of calcium and phosphorus in the blood are difficult analyses that routine clinical laboratories will handle only with a wide range of error. Single determinations of serum calcium levels are not only valueless but positively misleading.

[3] von Recklinghausen (24) in his original communication proposed the name "ostitis fibrosa osteoplastica."

TABLE I.*—CHEMICAL DETERMINATIONS

Disease	Concentration in blood			Excretion on low calcium diet			
				Urine		Fæces	
	Calcium	Phosphorus	Phosphatase	Calcium	Phosphorus	Calcium	Phosphorus
Hyperparathyroidism	High	Low	High	High	High	Normal	Normal
Tetany due to parathyroid deficiency	Low	High		Low	Low	Normal	Normal
Osteitis deformans (Paget's disease)	Normal	Normal	Very high	Very high	Very high	High	High
Osteomalacia from deficiencies Rachitis	Normal or low	Low	High	Low	Low	Low	Low
Arthritis (both types)	Normal	Normal	Normal or low	Normal	Normal	Normal	Normal
Hyperthyroidism (exophthalmic goiter)	Normal	Normal	High	Very high	Very high	High	High
Steatorrhœa difficulty in absorbing calcium from intestinal tract	Normal or low	Low	Normal or slightly elevated	Low	High	High	Normal

*Adapted from J. C. Aub.

of affairs in Case 3 produced a picture closely resembling renal rickets with an elevated serum calcium, a normal or slightly elevated serum phosphorus, a urinary calcium excretion within normal limits but a definitely increased fæcal calcium excretion.

In listing the clinical manifestations of the disease (1), the characteristic skeletal changes may be placed first in order of importance: generalized decalcification; bone tumors such as epulis or giant-cell tumors in other bones; fish-type vertebral bodies with kyphosis and skeletal shortening; fractures following minimal trauma and bone tenderness. As a close second in order of importance may be listed the calcification of the kidneys and diminished renal function with or without the formation of renal or ureteral calculi either unilateral or bilateral. Other signs and symptoms of hyperparathyroidism as recorded by Bauer are polydipsia, polyuria, weakness and loss of strength, constipation, loss of appetite, loss of weight, indefinite muscle and joint pains, and frequently anæmia with leucopenia. The high tide of calcium in the blood carries with it a decreased excitability of the nerves and characteristic changes in the electrocardiogram. The clinical manifestations of 11 cases studied and treated at the Massachusetts General Hospital are presented in tabular form in Table II.

Hyperparathyroidism is therefore a distinct disease entity with a definite train of symptoms and signs and a characteristic disturbance in metabolism and morbid anatomy. In each of the 11 cases here reported there has been found a grossly recognizable adenoma of one of the parathyroid bodies and the changes in calcium and phosphorus metabolism that are associated with an increased secretion of the parathyroid hormone. Extirpation of the tumor has in every case led to a reversal of the metabolic changes and to improvement based on objective findings. A carefully evaluated result must always rest as the final proof of a correct diagnosis and proper therapy.

PARATHYROIDECTOMY IN OTHER DISORDERS

The removal of one or more parathyroids has been recommended for several different conditions other than the malady described. The evidence supporting these recommendations is for the most part of a highly questionable nature. The procedure dates back to reports in 1928 of Oppel and his assistant Ssamarin of parathyroidectomy performed in about 70 cases of ankylosing polyarthritis. The diagnosis of hyperparathyroidism depended usually upon single determinations of the serum calcium. There was no mention of diet control; so on this basis alone the determinations are of doubtful significance. No metabolic studies were made. Electrical determinations of muscle excitability were recorded both before and after operation, but curiously enough the reactions as

quoted point to increased parathyroid activity following operation.

Added to his lack of convincing data, Oppel's physiologic argument is unsound. The removal of one or at most two of a probable four normal parathyroid glands is advised with the expectation of reducing the secretion of parathormone. We are aware that Ssamarin subsequently published a report describing histological changes in the extirpated glands, but we believe that he is describing the variation in appearance of the normal gland. In this we are supported by Gold. It is a matter of common knowledge that the functional integrity of glands of internal secretion is protected by a wide margin of safety. A large portion of a normal gland can be removed without measurable effect on the body. If from a normal gland enough tissue can be removed to cause hypofunction, the condition tends to be corrected rapidly by hypertrophy of the residual tissue.

Leriche and his assistants, following the lead of Oppel also removed normal parathyroid bodies in cases of ankylosing polyarthritis. Leriche is somewhat more conservative in believing that not all cases are suitable for parathyroidectomy but like Oppel, bases his diagnosis of hyperparathyroidism on isolated findings of slightly elevated blood calcium. Again, Leriche fails to control the diet of his patients. The differences in blood calcium levels before and after operation are within the limits of error of the method. The symptoms in his first case recurred after 6 weeks.

Leriche also recommends the ligation of one of the inferior thyroid arteries if a parathyroid body cannot be found, terming such a procedure a "physiological parathyroidectomy." From the excellent anatomic study of de Quervain and Curtis demonstrating the free arterial anastamosis between the thyroid arteries, the efficacy of such an operation seems very questionable. In later cases Leriche reports some determinations of the urinary calcium excretion but as he fails to mention any control of the dietary intake, the results are without meaning.

Following the report of Oppel, Ballin in this country recounted 16 parathyroid operations in cases of arthritis. Like Oppel and Leriche, in his diagnosis of arthritis supposedly due to excessive parathyroid activity, Ballin depends upon isolated elevated blood calcium determinations. He fails to say whether they were fasting blood levels which obviously it is important to know. Funsten, who has had certain cases of ankylosing polyarthritis operated upon by Dr. Ballin with gratifying results, advises several determinations of the serum calcium and if one or two elevated values are obtained makes a diagnosis of hyperparathyroidism. Our medical colleagues in their own work ascribe such transitory elevations in serum calcium to a failure to obtain a fasting blood sample or to an error in technique. Also, as has been emphasized, a serum calcium determination marks only the level of the tide in the blood and tells nothing concerning the direction of its flow into the bones on one hand or into the excretory channels on the other. The clinical improvement that Oppel, Leriche, and Ballin found following parathyroidectomy in cases of arthritis may readily be explained as the effect of the anæsthesia, rest in bed, a change in diet, or simply as a spontaneous remission that so frequently characterizes this disease. Arthritis has not been observed as a symptom in any one of the 11 cases of proved hyperparathyroidism studied at the Massachusetts General Hospital, although many cases were far advanced and of years' duration. Conversely, Bauer has studied the total calcium and phosphorus metabolism in both types of arthritis, choosing cases with marked bone atrophy on one hand and marked proliferative bone changes on the other. No changes of a degree sufficient to suggest a diagnosis of hyperparathyroidism were observed.

In his later papers Ballin recommends parathyroidectomy in Paget's disease on the basis that this disease is due to excessive parathyroid activity. It would be tedious to enumerate the many differences that exist between Paget's disease and hyperparathyroidism. They have been admirably summarized by Bauer. The case reports of Ballin offer the same unconvincing evidence that characterizes his work on arthritis. Snapper, in Amsterdam, in 2 carefully studied cases of Paget's disease found no demonstrable change

in calcium metabolism or clinical manifestations following parathyroidectomy. At the insistence of the patient one of us has removed a normal parathyroid gland in a case of Paget's disease with similar negative results to date. Schmorl, in a careful postmortem study of 190 cases of Paget's disease, failed to find histological evidence of increased activity in any of the parathyroid glands. This author also points out the differences that characterize the changes in the bones in the two diseases, hyperparathyroidism and Paget's disease.

It is to be noted, however, that in his second case Ballin found "a marked parathyroid adenoma." The possibility of the coexistence of the two diseases must be admitted, and has been further confirmed by the experience of a colleague with a case in which a dual diagnosis was made on the basis of X-ray and metabolism findings and a parathyroid tumor discovered at operation (29). The bone changes as revealed by X-ray in Case 8 of our series were quite typical of Paget's disease. It may be that an unduly high incidence of parathyroid adenomata will be found in cases of Paget's disease but certainly the autopsy findings of Schmorl discourage such a belief at the present time, as also do the metabolic studies of Bauer and Aub and of Snapper.

A diffuse hyperplasia of all of the parathyroid bodies may exist in disease states associated with a low serum calcium such as osteomalacia, rickets, and senile osteoporosis. According to Albright, this is presumably a compensatory mechanism and is not usually associated with an elevation of the serum calcium. Diffuse hyperplasia of the parathyroids associated with hyperparathyroidism—in other words, a state of affairs analogous to Grave's disease of the thyroid—has not as yet been recognized as a disease entity.

TABLE II.—CLINICAL MANIFESTATIONS

		Case number										
		1	2	3	4	5	6	7	8	9	10	11
Skeletal	1. Decalcification (generalized)	+	+	+	+	+	+	+	o	+	+	+
	2. Cysts	+	o	+	+	o	+	+	+	o	o	+
	3. Previous operations for tumors or cysts	+	o	+	o	o	o	o	o	o	o	+
	4. Skeletal shortening	o	o	o	+	o	*	o	o	o	o	+
	5. Fractures	+	+	+	+	o	+	+	o	o	+	*
	6. Epulis	o	o	o	o	o	o	o	o	o	o	+
Urinary	1. Polyuria	o	o	*	+	+	+	+	o	+	+	+
	2. Diminished renal function			+	+		+	o	o	+	+	+
	3. Albuminuria	o	o	+	+	+	+	o	+	o	+	+
	4. Renal, ureteral or vesical calculi	o	o	o	+	*	+	o	+	o	*	o
	5. Calcification of renal cortex	o	o		o	o	+	o	o	+	o	o
General	1. Polydipsia	o	o	+	+	o	+	o	o	+	o	+
	2. Weakness	+	+	+	+	+	+	o	o	+	+	+
	3. Loss of weight	+	o	+	o	+	+	+	o	+	+	+
	4. Constipation	+	+	o	+	+	+	+	o	o	o	+
	5. Loss of appetite	+	o	+	o	o	+	+	o	o	+	+
	6. Muscle and joint pains	*	*	o	*	o	+	*	*	*	+	+
	7. Hypochromic anæmia	+	o	+	+	+	+	+	o	+	o	+
	8. Nervousness	+	+	o	o	o	+	o	o	o	o	+
Metabolic findings	1. Elevated serum calcium	+	+	+	+	+	+	+	+	+	+	+
	2. Increased urinary calcium	+	+	o	+	+	+		+		+	+
	3. Low serum phosphorus	+	+	o	+	+	+	+	+	+	+	+
	4. Increased urinary phosphorus	+	+	+	+	+	+		+		+	+
	5. Increased plasma phosphatase		o	+	+	+	+	+	+	+	o	+
Miscellaneous	Biopsy of bone osteitis fibrosa	+		+	+		+	+		+	o	+
	Palpable tumor in neck	+	o	o	o	o	o	o	o	+	o	o
	Tetany following operation Absent Mild Severe	+	+	+	+	+	* +	+	+	+	+	+
	Number of operations previously done in search of tumor	o	o	o	1	o	6	2	o	o	o	o

* = Chief or first complaint.

SURGICAL PATHOLOGY[1]

It is the unusual case of hyperparathyroidism that presents a palpable tumor on physical examination. In fact only 2 of the 11 cases gave external evidence of a tumor in the neck. This is due both to the fact that the tumors lie deep in the neck or mediastinum and to the pliant nature of the parathyroid tissue that molds itself to conform to adjacent structures. Grossly adenomatous parathyroid tissue resembles that of the normal gland in color. Certain of the tumors have a well defined capsule at times thickened by calcification. A well developed capsule conceals the characteristic brown color which only becomes evident when the tumor is sectioned. If the

[1] A histological study of this series of tumors will be reported at a future date.

tumor is large its nature is easily recognized when it is exposed at operation. Considerable difficulty may be encountered in distinguishing a small adenoma from a normal parathyroid body in the gross. Comparison with adjacent parathyroid bodies may give a clue but a surprisingly large variation in size exists between the normal glands.

Considerable practice both in the postmortem room and at the operating table is necessary to train the eye to distinguish the normal parathyroids with surety. Surgeons with extensive experience in the surgery of the thyroid have confessed to the difficulties of the recognition of a parathyroid body in the gross even with the aid of a magnifying glass or loupe. The parathyroids are most readily confused with small nodules of thyroid tissue, lymph or hæmolymph nodes, or small collections of empty fat. The color of fat tissue containing little or no fat substance is almost identical to that of parathyroid tissue. It is slightly softer, however, and more friable and the small masses that are invariably encountered in the dissection lack the characteristic shape and tiny vascular pedicle that serve to identify a parathyroid body. This type of fat is very apt to be found along the carotid sheath. With experience, the parathyroids can be identified with great accuracy as checked by histological section. In one operative case, with patience and extreme care in dissection we have identified as many as four grossly normal parathyroids. It is an interesting coincidence that just at this time the proposed operation of total thyroidectomy in heart disease also demands that the surgeon train himself in the identification and preservation of normal parathyroids.

Unless the tumor is palpable the search for it may be one that taxes the patience and resources of the surgeon. That the parathyroid glands should occupy varying positions in the neck is only reasonable from a study of their embryological development. The parathyroids are formed principally from lateral anlagen of the third and fourth pharyngeal pouches (Fig. 2). Getzowa has reported parathyroid tissue originating in the fifth pouch as well, an observation that explains the occasional presence of more than four glands. Parathyroids and thymus descend laterally during development and may maintain their close proximity in the adult. Thyroid tissue develops from the medial aspects of the third pair of pouches and descends in the midline. In addition, thyroid tissue develops laterally from the ultimobronchial bodies. From an embryological basis it is thyroid tissue of this origin that would be likely to harbor a parathyroid inclusion.

It is theoretically possible to encounter parathyroid tissue anywhere from the pharynx to the mediastinum. No parathyroids have been reported as far as we are aware above the level of the upper poles of the thyroid gland, yet it may well be that parathyroid rests will be found in the upper neck just as thyroid tissue occurs in this region. If such be the case they may be expected to lie on the posterolateral aspects of the pharynx and not in the midline as does lingual goiter. At a lower level, parathyroid tissue occupies the same positions described for lateral goiters. How low parathyroid tissue may descend into the mediastinum is not known. We have encountered two tumors in the anterior mediastinum, one just above the great vessels on the left side and the other just below the left innominate vein, almost in the midline. Walton describes a tumor at about this same level in the posterior mediastinum and gives an excellent description of the routes of descent into the mediastinum.

We have found no normal parathyroid bodies or tumors posterior to the deep cervical fascia and there is no report of such a finding in the literature. Similarly none has been found anterior to the middle cervical fascia which lies just beneath the sternohyoid and sternothyroid muscles forming the so called outer capsule of the thyroid gland.

The space bounded posteriorly by the deep cervical fascia resting on the anterior surface of the longus colli muscles, anteriorly by the middle cervical fascia, limited above by the pharynx and extending for an unknown distance downward into the mediastinum is therefore the region of search for a parathyroid tumor.

To assume that the parathyroids always lie in close proximity to the thyroid gland has proved a pitfall for the unwary surgeon. It is also erroneous to consider them symmetrically placed and four in number. Welsh in 1898 pictured a parathyroid resting on the deep cervical fascia posterior to the œsophagus. MacCallum also found many glands at some distance from the thyroid. From a relatively small series of dissections checked by microscopic sections we are inclined to believe that the more careful the search and the wider afield it is carried the more glands will be found far away from the immediate vicinity of the thyroid. In each of two postmortem dissections five parathyroid bodies have been disclosed.

Parathyroid tumors and normal glands have been reported as lying within the substance of the thyroid gland. Theorectically it is possible, but we have not encountered such a case. A parathyroid body may be buried very deeply in a thyroid sulcus and give the appearance both gross and microscopic examination of being surrounded by thyroid tissue.

The widely spaced locations of even a small number of tumors (Table III) attest the truth of the statements made and the fact that 3 of 11 cases had had at least one previous operation in an unsuccessful attempt to find the tumor emphasizes their practical surgical application.

TABLE III—ANATOMICAL POSITIONS OF ELEVEN PARATHYROID TUMORS

In contact with thyroid	
Left upper pole	2
Left lower pole	2
Right upper pole	0
Right lower pole	2
Retrotracheal	1
Retrocœsophageal	2
Anterior mediastinum	2

OPERATIVE SURGERY

The golden opportunity to find a small parathyroid adenoma lies in the first surgical exploration of the neck. The search through scar tissue at a secondary operation offers many further obstacles to success. Meticulous hæmostasis is essential as the staining of the loose areolar tissue with blood makes the recognition of parathyroid tissue exceedingly difficult or impossible. Even the smallest vessels encountered in the dissection are doubly ligated with fine silk before sectioning. The most careful handling of all tissues by sharp dissection is imperative. Even slight trauma to a parathyroid body may cause a hæmatoma to develop within its substance with lightning-like rapidity and completely mask its identity. A parathyroid with hæmorrhage into its tissue resembles nothing more than a ripe currant. Such trauma or interference with the integrity of its vascular pedicle will increase the risk of postoperative tetany.

Cutting into the thyroid gland is to be scrupulously avoided on account of the hæmorrhage that obscures the operative field. Traction stitches of fine silk are used instead of double hooks to retract the thyroid. The technique as a whole is that of a neurosurgical procedure rather than that of a subtotal thyroidectomy.

The following method of procedure is recommended after a diagnosis of hyperparathyroidism has been definitely established. First, a special pre-operative study is made by the roentgenologist in an attempt to locate the tumor. This may be productive only in the advanced case with a sizeable tumor but should be tried in all cases. Films are taken to outline the trachea and penetrate the superior mediastinum. These are studied for the presence of a calcified capsule or displacement of the trachea. A swallow of thick barium is employed to outline the œsophagus in both anterior and lateral views. A filling defect or displacement of the œsophagus may indicate the position of the tumor. The presence of a nodular goiter with a substernal right lower pole was misleading in one case and the parathyroid tumor was ultimately found at the left upper pole.

In choosing an anæsthetic the preferences of the individual surgeon will undoubtedly play a rôle. As the operation may be a prolonged one, ether has been employed rather than a bilateral cervical nerve block with local anæsthesia. Complete lack of motion in the operative field is helpful and supplementary infiltration of tissues with a local anæsthetic

increases the difficulties of clean dissection. Avertin is, of course, contra-indicated in the case of patients with kidney damage. Nitrous oxide oxygen has not been employed because of its reputation for increasing venous oozing in the operative field. For exploration of the mediastinum positive pressure is advantageous.

A wide collar incision is employed with section of the pretracheal muscles and dissection of the middle cervical fascia from the surface of the thyroid. The position of the thyroid is studied to note any displacement or undue prominence of either lobe that might indicate a tumor behind it. The carotid sheaths are then identified and the lateral thyroid veins cut between ligatures. The posterolateral aspects of the thyroid are then palpated and examined under direct vision. Dissection is carried down on one side until the recurrent nerve is identified and the region of the terminal divisions of the inferior thyroid artery exposed. This is repeated on the opposite side. The trachea and œsophagus are then exposed and the dissection carried upward to the larynx and downward into the superior mediastinum. The branches of the inferior thyroid artery may be severed individually as they enter the capsule of the thyroid making sure that the blood supply of any normal parathyroid body is left intact (Fig. 6). The finger is passed into the posterior mediastinum behind the trachea and œsophagus. It is possible in this manner to identify structures as low as the right primary bronchus. Exploration of the anterior mediastinum is accomplished by inserting the finger behind the sternal notch deep to the middle cervical fascia. At the same time a finger of the other hand is passed into the posterior mediastinum on each side in turn. The structures of the mediastinum can then be palpated between the two fingers. It was only in this way that the tumor in Case 7 was identified in the anterior mediastinum just to the left of the midline. When once identified a substernal tumor can be delivered into the operative field by gentle traction. The two tumors we have encountered in the anterior mediastinum have been attached to vascular pedicles running down from the neck so that the base of the tumor could be delivered into the suprasternal notch with its blood supply intact. It is probable that any sizeable tumor located in the superior mediastinum can be identified and delivered into the neck without splitting the sternum if it is found at the primary operation. In Case 6, six previous operations on the neck had left such a legacy of scar tissue that the tumor was only found by a sternum splitting exploration.

The incidence of multiple adenomata is frequent enough to make the demonstration of three or four normal glands in addition to a tumor the ideal operation. This is a goal, however, that can rarely be achieved and only at the cost of increased risk in a very sick patient. Under such circumstances the recognition and resection of a grossly unmistakable tumor should be carried out with a minimum amount of dissection, and postoperative metabolic studies carried out to give assurance that the hyperparathyroid state has been arrested.

When operating with a well established diagnosis of hyperparathyroidism the removal of normal parathyroid bodies or the interference with their blood supply is absolutely contra-indicated even if no tumor is found. Such a procedure will not only be without demonstrable result (Case 6) but will increase the dangers of postoperative tetany when the tumor may be found at a later operation.[1]

Resection of a lobe of the thyroid in the blind hope of discovering a small parathyroid tumor deep in its substance may be undertaken particularly if it contains a single suspicious nodule. It should be done, however, only at the conclusion of the extended search outlined, and has not been found advisable in cases we have seen. Walton resected a solitary thyroid adenoma believing it to be of parathyroid origin; Compere recounts a similar experience. The coexistence of a nodular

[1]Case 6 in this series has been erroneously quoted in the literature as showing improvement following the removal of two normal parathyroid bodies. The improvement was symptomatic and temporary and may be ascribed to a high calcium diet. A tumor was found at a later date.

An interesting and puzzling case is recorded by Hitzrot and Comroe who observed an improvement in calcium metabolism and in skeletal pathology following the removal of three normal parathyroid bodies. Is it possible that a small tumor was overlooked and that the removal of three normal glands restored a normal balance of parathormone secretion? A report on the future course of this patient will be awaited with interest. It is the only well studied case in the literature in which improvement is recorded following the extirpation of normal parathyroids.

goiter as in Case 11 may add considerably to the difficulty of the search for a parathyroid tumor.

If no tumor is found after a complete dissection of the neck and palpation of the mediastinal structures, the diagnosis is rechecked during the convalescent period. If a bone biopsy has not already been done, it is well to remove a small button from the sternum with a trephine at the conclusion of an unsuccessful operation. If no doubt exists as to the diagnosis, exploration of the mediastinum under direct vision by section of the sternum is now indicated. With positive pressure anæsthesia a midline incision is carried downward from the sternal notch sweeping to the right at the level of the third costal cartilage. By blunt dissection at the sternal end of the third interspace a finger is inserted into the mediastinum and directed upward behind the sternum pushing the great vessels backward to avoid injury. The sternum may then be split with a Lebsche sternum knife and retraction of the two halves brings the anterior mediastinum into view. This was done in the case of Captain Martel (Case 6) and the tumor disclosed lying just below the left innominate vein.

As a final effort to locate a tumor a block dissection of the neck above the larynx may be undertaken on embryologic grounds, as to our knowledge no tumor or normal parathyroid tissue has been found in this area. This was done in Case 6 before the anterior mediastinotomy as a less radical procedure and because at that time no tumor had been described in the anterior mediastinum. At the present time we should postpone this dissection to the last.

SECONDARY OPERATION

In 3 of our 11 cases one or more attempts to find the tumor had been made by other surgeons. The difficulty of secondary operations on the thyroid gland is well known. The added difficulties in a search for parathyroid tissues may well be imagined. In Case 5 one recurrent nerve had been paralyzed at a previous operation. In general we have followed the principles suggested by Clute for secondary operations on the thyroid. After section

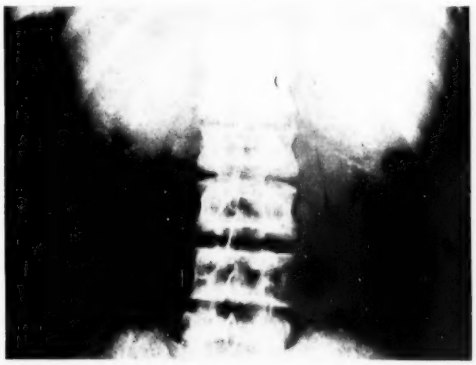

Fig. 1. Diffuse bilateral calcification of renal cortex in hyperparathyroidism.

of the pretracheal muscles, the deep areas of the neck are entered on both sides through the carotid sheaths. Having identified and retracted the great vessels and the vagus nerves laterally, the trunks of the cervical sympathetics are found marking the deep cervical fascia. The recurrent nerves are isolated as low as possible and traced upward toward the larynx. The thoracic duct has been identified in each case to prevent injury to it.

The scar tissue in the region of the thyroid is not explored until the search has been carried far afield. In the dissection of this scarred area damage may unwittingly be done to normal parathyroids or their vascular pedicles. It is also probable that a tumor in this area would have been identified by the first operator.

SUBTOTAL PARATHYROIDECTOMY

In the 3 cases (4, 6, 7) in which secondary operations were performed two normal parathyroids had been removed in each at earlier operations. In addition an unknown amount of damage had been done to other normal glands or their blood supply. It seemed advisable therefore when the tumors were found to do subtotal resections.

Having no precedent by which to estimate the relative activity of adenomatous and normal parathyroid tissue, each case was judged on the basis of the size of the tumor and the known degree of hyperparathyroidism. Again, the ultimate fate of the tissue that was left is unknown; whether it will behave like the

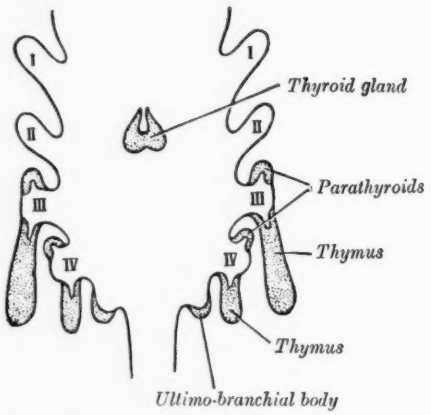

Fig. 2. Scheme showing origin of parathyroid tissue (Gray's *Anatomy*).

residuum of a nodular goiter or whether it is potentially malignant (15) only the future course will reveal. In each case the capsule was resutured to form a compact body and its location clearly marked. In dealing with the mediastinal tumors (Cases 6 and 7) the residual tissue was transferred to the neck with its vascular pedicle intact. All 3 cases showed marked tetany even with subtotal resection.

In certain very advanced cases, particularly with extensive decalcification of the bones, subtotal resection may well be indicated even if the normal parathyroids are presumably intact. Prolonged and severe tetany has been observed following the removal of a large adenoma even when a very limited dissection made damage to other parathyroids impossible (Case 9). In the experience of others death from uncontrollable metabolic disturbance has occasionally followed total resection of a tumor. In Case 11 the patient had suffered extreme bone decalcification from a disease of long duration so a subtotal resection was done as the operation of election to avoid plunging her into a severe and perhaps fatal tetany. The result was a return to normal metabolism with only very slight and transient hypocalcæmia.

RESULTS OF OPERATION

The immediate result in the cases from which a parathyroid tumor has been removed either completely or by subtotal resection, has been a correction of the disturbance in calcium and phosphorus metabolism. In fact, postoperative studies showing the return to normal constitute the final step in establishing the diagnosis and efficacy of the treatment. They are notably lacking in the reported cases of Paget's disease and arthritis. Following removal of the tumor in true hyperparathyroidism the serum calcium values fall with dramatic rapidity (Fig. 12). Symptoms and signs of tetany may appear even with a serum calcium above the normal level when hypercalcæmia has been present for a long time. The tetany is controlled by high calcium diet administration of calcium gluconate, irradiated ergosterol and parathormone.

Improvement in many of the symptoms of hyperparathyroidism may be expected within a few days. In several instances the patient has only been made conscious of certain long

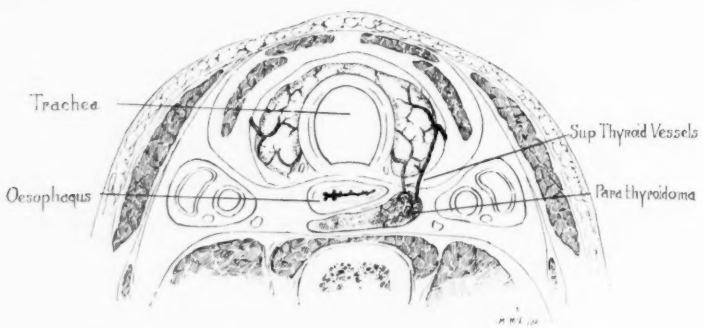

Fig. 3. Diagram showing retrooesophageal tumor found in Case 4.

standing but ill defined symptoms such as loss of energy, constipation or fatigue by their abrupt cessation following operation. These symptoms are then recognized in retrospect as manifestations of the disease. The muscle and joint pains as well as bony tenderness are promptly relieved. The replacement of calcium in the bones takes a longer time and many months may elapse before any change becomes apparent by X-ray. The bone tumors being osteoclastomata, may be expected to disappear, but the bone cysts formed by fibrous replacement of bone substance persist.

How far the kidney damage may be repaired is not known. In certain cases some improvement in renal function has been observed. The only fatality in the 11 cases here presented (Case 6) occurred following the removal of a ureteral stone several weeks after the resection of a parathyroid adenoma.

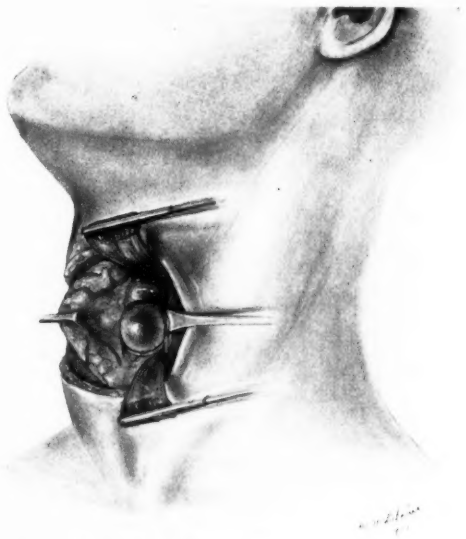

Fig. 4. Parathyroid tumor exposed by elevating lobe of thyroid. The inferior thyroid artery formed a sling which may have prevented this tumor from descending into the posterior mediastinum, as it lay on the deep cervical fascia. Only the upper third of the tumor is shown in the cut.

SUMMARY

Hyperparathyroidism is a distinct disease entity associated with a definite train of symptoms and a characteristic disturbance of calcium and phosphorus metabolism. It is constantly associated with a demonstrable adenoma usually of gross size of one or more parathyroid bodies. Following the total or subtotal resection of the tumor the calcium and phosphorus metabolism returns to normal, usually after a more or less prolonged period of tetany.

The beneficial effects said to follow the removal of one or more normal parathyroids in certain cases of arthritis or in Paget's disease are, to say the least, viewed with skepticism.

The plan of operation in a proved case of hyperparathyroidism is outlined.

The method of dealing with parathyroid tumors contained in the mediastinum is described and two such cases reported.

The removal of normal parathyroid bodies or interference with their blood supply when operating with a definite diagnosis of hyperparathyroidism is absolutely contraindicated.

Subtotal resection of a parathyroid tumor is advisable when normal glands have been removed or damaged at a previous operation. Subtotal resection may also prove to be the operation of election in a very sick patient to lessen the dangers of severe tetany. It has been done in one such case. The fate of the residual tissue being unknown at the present time, complete resection is the operation of choice.

Case histories of 11 patients with hyperparathyroidism in which an adenoma was removed at operation are appended.

APPENDIX

The case histories and laboratory findings have been abbreviated because in many instances the complete data have been given in other publications. Single values have been cited for blood chemistry determinations although in every instance these have been checked repeatedly with the patient on a test diet low in calcium. Ten to 20 or more determinations are on record for nearly every case. The clinical histories of these cases have been made the basis of a paper by Albright, F., J. C. Aub and Walter Bauer entitled "Hyperparathyroidism: A Common and Polymorphic Condition as Illustrated by Eleven Cases from One Clinic" (To be published).

CASE 1. M.J.S., female, aged 46 years, in 1916 noted swelling in right side of neck following miscarriage; in 1925, onset of nervousness; in 1928, neuritis in right arm; in 1929, pain and soreness in right thigh with difficulty in walking, which extended to left

Fig. 5. Parathyroid tumor situated between trachea and œsophagus posterior to the recurrent nerve. Insert shows the tumor when delivered.

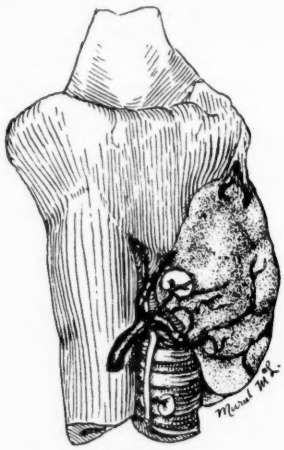

Fig. 6. Sketch from actual autopsy dissection (by R. H. Linton). The inferior thyroid artery may be divided at a point between the artery to the parathyroid and the capsule of the thyroid gland. This technique has been useful in complete thyroidectomy. A second parathyroid body is shown on the lateral aspect of the trachea.

thigh after 3 months; in 1930 severe pain in right forearm. Biopsy on right ulna at Worcester Memorial Hospital showed giant cell sarcoma. X-ray therapy. Increasing numbness and pain in legs. Entered Massachusetts General Hospital. X-ray examination showed generalized osteitis fibrosa cystica. Secondary anæmia. Serum calcium 13.68 milligrams, serum phosphorus 2.58 milligrams.

December 9, 1930. Operation. R. H. Miller. Palpable tumor pushing right lobe of thyroid forward. Hemithyroidectomy with total resection of tumor. Pathology: Specimen 6.5 by 5 by 3.5 centimeters, weighing 53.2 grams. Benign tumor of parathyroid body. Thyroid tissue normal.

February 16, 1931. Improvement in appetite, strength, gait, and pains in legs. Calcium and phosphorus levels normal. Anæmia still present.

July 27, 1931. Gained 40 pounds since operation. Cessation of all skeletal pain. Strength better than since 1916. Constipation disappeared. X-ray films show slight but definite improvement in bones.

January 26, 1932. Still reports further improvement. All soreness and lameness in thighs gone. Nervousness replaced by calmness. X-ray films show definite increase in bone density. Cysts practically unchanged in size.

August 4, 1933. Feels very well. Some backache. Cysts unchanged by X-ray.

CASE 2. M.L., female, aged 60 years. In 1928 noted pain in back intensified by motion; swollen and painful shoulder, knee and ankles.

February 25, 1931. Diagnosis of mild hypertrophic arthritis and osteomalacia. Serum calcium 10.4 milligrams, serum phosphorus 3.6 milligrams. Treated by high calcium diet and viosterol, with considerable relief of symptoms.

June 6, 1931. Pain in ankles and aching pain in knees. Condition thought to be osteoporosis because of consistently low phosphorus.

October 5, 1931. Considerable symptomatic improvement but still subject to fatigue and inability to work. Severe aching pain in right foot attributed to fallen arch. Swelling of right foot and ankle. Careful studies showed slight but constant elevation of serum calcium and low serum phosphorus. Diagnosis of hyperparathyroidism.

January 14, 1932. Operation. Right lower parathyroid body appeared considerably larger than normal. Located in contact with thyroid capsule just below lower branch of inferior thyroid artery. The recurrent nerve divided into two branches at the level of the inferior thyroid artery and one of these was accidentally severed. A careful suture with arterial silk was performed. The enlarged parathyroid, subsequently proved to contain an adenoma, was removed. Pathology: Specimen measuring 10 by 5 by 4 millimeters. Benign tumor of parathyroid body with sharply circumscribed margin and peripheral layer of normal appearing cells.

Convalescence. No tetany. Voice hoarse but vocal cords move normally and equally.

July 12, 1932. Very optimistic. Gained considerably in weight. Back feels strong.

May 27, 1933. Feels very much better. Working.

CASE 3. C.S. (Albright, F., P. C. Baird, O. Cope, and E. Bloomberg, Am. J. M. Sc., in press), female, aged 13 years. In 1928, patient noted increase in nocturia with enuresis and polyuria. Always drank large amounts of water. In 1928 fracture of right for-

Fig. 7. First step in anterior mediastinotomy (after Sauerbruch).

Fig. 8. Parathyroid tumor (Case 6) exposed by retraction of the two halves of the sternum. The vascular pedicle extended downward from the neck, the tumor lying below the left innominate vein.

arm in two places following injury of considerable violence. In 1930 limp attributed to fallen arches. Six months later noted deformity of left knee and a cyst was removed from lower end of the femur. In 1931 began to note deformity of right knee.

January 1, 1932. Loss of appetite.

February 1, 1932. Bleeding from gums.

March 17, 1932. Entered Massachusetts General Hospital. X-ray films of skull, pelvis, and vertebræ were characteristic of hyperparathyroidism. Almost complete decalcification of epiphysis suggesting renal rickets interpreted as failure of calcification of growing cartilage. Serum calcium 12.5 milligrams, serum phosphorus 4.7 milligrams. Phosphatase 36.00 units. Urinary calcium excretion within normal limits. Fæcal calcium definitely increased. Greatly reduced renal function and elevated nonprotein nitrogen.

April 9, 1932. Operation (Fig. 5). Right lobe of thyroid slightly more prominent than left. Tumor found between trachea and œsophagus and resected. Pathology: Specimen measuring 22 by 17 by 10 millimeters and weighing 2.5 grams. Benign tumor of parathyroid body. Bone biopsy showed osteitis fibrosa.

Convalescence: Serum calcium fell 6 hours after operation to 10.36 and reached 8.26 milligrams in 22 hours. Moderate tetany.

May 9, 1932. Serum calcium 5.67 milligrams, serum phosphorus 5.00 milligrams.

May 14, 1933. Feels very strong. No polyuria or nocturia. Still subject to ready fatigue. X-ray films show definite improvement.

CASE 4. N.B. (Albright, F., W. Bauer, D. Claflin, and J. R. Cockrill, J. Clin. Invest., 1932, xi, 411; Albright, F., B. C. Baird, O. Cope, and E. Bloomberg, Am. J. M. Sc., in press), female, aged 41 years. In 1925 following fifth pregnancy, patient noted weakness in back and knees and pain in legs on walking. In 1927 these symptoms increased with sixth pregnancy. Treated for fallen arches. In 1928 had fracture of right femur. Told she had "bone disease." In 1929 fracture right clavicle, and later fracture of right humerus. In 1930 entered Massachusetts General Hospital. X-ray film showed marked decalcification of skeleton, cyst formation, and old pathological fractures. A renal calculus was noted. Serum calcium was 14.25 milligrams, serum phosphorus 2.3 milligrams.

September 12, 1930. Operation. No tumor found. Search limited to immediate region of thyroid gland. Two normal parathyroid bodies removed. Pathology: Normal parathyroids.

A high calcium diet with viosterol gave improvement in symptoms and X-ray showed increased deposit of calcium in skull. As evidence of hyperparathyroidism persisted she returned to the hospital.

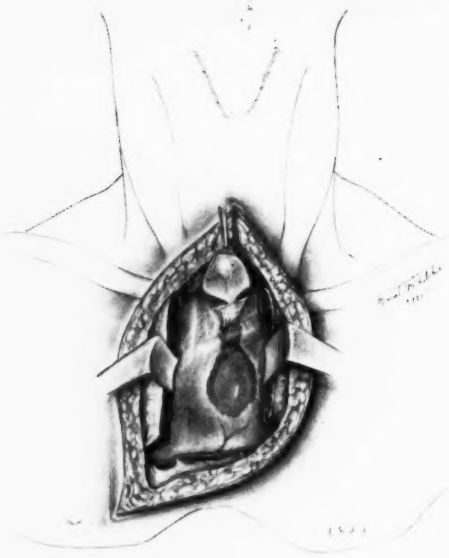

Fig. 9. Subtotal resection of the tumor (Case 6) because of the fact that at least two normal parathyroids had been previously removed.

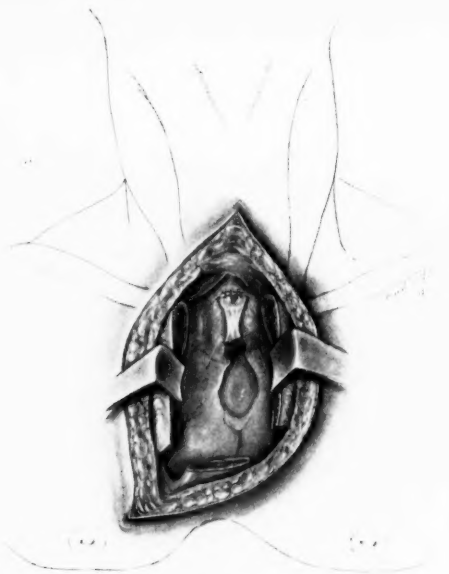

Fig. 10. Fixation of residual tumor tissue in the sternal notch with vascular pedicle intact.

September 28, 1932. Operation (Figs. 3 and 11): Large tumor (3.5 by 2 by 1 centimeters) found behind the œsophagus on surface of deep cervical fascia. Subtotal resection. Pathology: Benign tumor of parathyroid body.

Moderately severe tetany during convalescence.

December 20, 1932. Serum calcium 8.0 milligrams, serum phosphorus 4.0 milligrams and phosphatase 4.3 units.

February 7, 1933. Feeling much better. Anæmia improved.

August 8, 1933. Doing well.

CASE 5. R.T., female, aged 55 years. In 1922 patient had attacks of severe pain in right flank radiating to epigastrium. In 1927 gall bladder was removed for continuing attacks of pain. In 1931 attacks of pain had not been relieved by operation—becoming more severe. Easily fatigued.

September 1, 1932, entered Massachusetts General Hospital. X-ray films showed stone in pelvis of right kidney. This was removed by pyelotomy. Routine blood chemistry studies showed serum calcium 13.2 milligrams, serum phosphorus 2.78 milligrams. Phosphatase 5.0 units.

October 3, 1932. Operation: Tumor below left lower pole of thyroid resected. Pathology: Specimen 1.5 by 1 by 1 centimeters. Benign tumor of parathyroid body.

Convalescence—very mild tetany.

CASE 6. C.M. (Richardson, E. P., J. C. Aub, and W. Bauer, Ann. Surg., 1929, xc, 730; Hannon, R. R., E. Shorr, W. S. McClellan, and E. F. Du Bois, J. Clin. Invest., 1930, viii, 215; Bauer, W., F. Albright, and J. C. Aub, J. Clin. Invest., 1930, viii, 239; McClellan, W. S., and R. R. Hannon, J. Clin. Invest., 1930, viii, 249; Albright, F., W. Bauer, D. Claflin, and J. R. Cockrill, J. Clin. Invest., 1932, xi, 411; Albright, F., P. C. Baird, O. Cope, and E. Bloomberg, Am. J. M. Sc., in press). The clinical history of Captain Martel has appeared so often in the literature that no attempt will be made to repeat it. The diagnosis by Dr. Eugene Du Bois was the first clinical recognition of hyperparathyroidism in this country and probably the second in the world. The cooperative attitude of the Captain made possible a series of metabolic studies that are unparalleled and have contributed enormously to our knowledge of the disease.

Operation was performed first by Dr. E. P. Richardson and two normal parathyroid bodies were removed. An article describing the case has been widely misquoted as recording improvement following this operation, but any such tendency was temporary and better attributed to the high calcium diet. As the disease progressed the renal damage became more marked and stones formed in the kidney pelvis. At the seventh operation (Figs. 7, 8, 9, 10) a parathyroid tumor was found in the anterior mediastinum by splitting the sternum. Subtotal resection was performed. Severe tetany supervened which was controlled with difficulty owing to acidosis attributable to the renal damage. Six weeks after

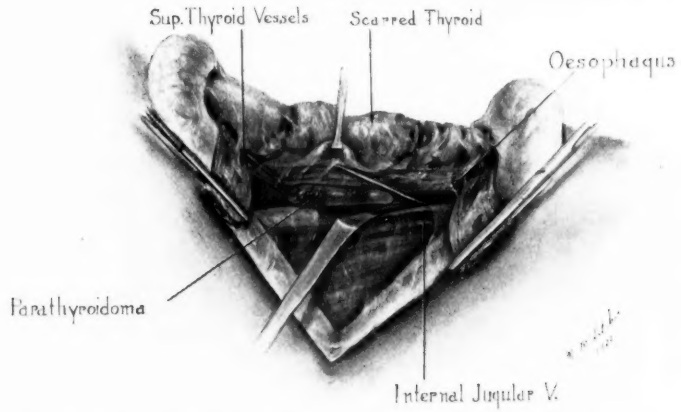

Fig. 11. Parathyroid tumor (Case 4) lying behind the œsophagus discovered at secondary operation (see Fig. 3).

the removal of the parathyroid tumor a stone was passed into the left ureter causing complete obstruction. With the patient in a dangerous balance between tetany and acidosis and in the face of markedly diminished renal function a left ureterotlithotomy was undertaken. Death occurred 26 hours later.

Case 7. M.R., female, aged 36 years. In 1929 noted onset of dull pain in arms and legs. In 1931 at hospital in Worcester, bones were found decalcified and filled with cysts. Diagnosis of osteitis fibrosa cystica. Serum calcium 14.1 milligrams, serum phosphorus 2.9 milligrams.

October 19, 1931. Operation (Memorial Hospital): Tumor, supposedly of parathyroid origin excised. Microscopic examination revealed thyroid tissue.

April 13, 1932. Biopsy of mandible showed osteitis fibrosa cystica.

May 6, 1932. Operation (Memorial Hospital): Exploration of neck with right hemithyroidectomy, and removal of tumor at left lower pole. Microscopic examination revealed thyroid gland and thymus gland.

September 9, 1932. High voltage X-ray therapy.

November 3, 1932. Entered Massachusetts General Hospital. Serum calcium 12.0 milligrams, serum phosphorus 1.74 milligrams. Phosphatase 16.9 units. X-ray films confirmed marked decalcification. Multiple fractures were noted in pubic bones. Paralysis of right vocal cord.

November 15, 1932. Operation: After exploration of neck, tumor was found in anterior mediastinum beneath costal cartilage of second rib at border of sternum. Subtotal resection. Pathology: Specimen 2.5 by 3 by 1 centimeters. Benign tumor of parathyroid body.

Convalescence: Definite tetany accompanied fall in serum calcium.

November 20, 1932. Serum calcium 5.16 milligrams, serum phosphorus 3.29 milligrams.

May 17, 1933. Bones show tremendous improvement. Bowels regular. Serum calcium 8.39 milligrams, serum phosphorus 3.03 milligrams. Phosphatase 5.08 units.

Case 8. A.R., female, aged 44 years. In 1931, began to have pain in right hip.

March 15, 1932. X-ray films at Huntington Hospital showed extensive destructive process in right ilium. No appreciable decalcification of skeleton. Serum calcium 14 milligrams, serum phosphorus 1.5 milligrams. Diagnosis of hyperparathyroidism by Dr. Aub. Treatment by high calcium diet with improvement of symptoms.

November 28, 1932. Entered the Massachusetts General Hospital. Localized area of rarefaction with areas of increased density in right ilium. Stone in right kidney pelvis. X-ray diagnosis of Paget's disease of ilium. No evidence of osteitis fibrosa cystica.

November 30, 1932. Operation: Tumor on right side posterior to thyroid lying against trachea. Excised. Pathology: Specimen 2 by 0.8 by 0.6 centimeters. Benign tumor of parathyroid body.

Convalescence—very slight tetany.

Case 9. J.R.C. (Eppinger, E., and H. Magendantz, J. of Roentgen., (in press), male, aged 33 years. In 1931 insidious onset of pains in legs while walking. Weakness. Loss of weight. Nocturia. In 1932 pain in legs almost constantly while upright. Weaker.

January 18, 1933. Unable to work. Loss of weight now 30 pounds. Very weak. Diagnosis of hyperparathyroidism at Boston Dispensary where X-ray films were taken of back and calcification of kidneys observed (Fig. 1). Mild polyuria and polydipsia. Serum calcium 17 milligrams.

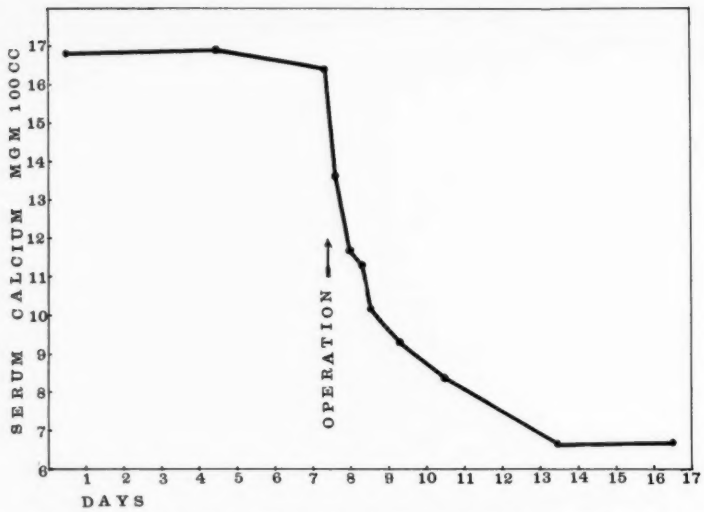

Fig. 12. Chart of serum calcium determinations preceding and following the removal of a parathyroid tumor(Case 9).

March 18, 1933. Entered Massachusetts General Hospital. Palpable tumor in region of left lobe of thyroid. X-ray films showed marked generalized decalcification of skeleton with cyst formation. Markedly depressed renal function and low specific gravity. Secondary anæmia. Serum calcium 16.9 milligrams, serum phosphorus 3.02 milligrams.

April 4, 1933. Operation (Fig. 4): Tumor found lateral and posterior to lower portion left lobe of thyroid. Medial aspect in contact with œsophagus. Total resection. Dissection limited to left side of neck. Pathology: Specimen 4 by 2.2 by 2 centimeters weighing 7 grams. Benign tumor of parathyroid body.

Convalescence marked by prolonged and severe tetany (Fig. 12) with stormy attacks of respiratory difficulty. Calcium chloride given intravenously on several occasions even on thirty-sixth postoperative day.

July 24, 1933. Steady improvement in appetite and strength. Gain of 30 pounds in weight. Much less pain on walking. Less nocturia. Anæmia improved moderately. Renal function same. Calcium and phosphorus values normal. Phosphatase slightly elevated. X-ray films show no demonstrable change in skeleton or kidneys.

Case 10. M.S., female, aged 54 years. At age of 15 years experienced severe "backstrain" which in light of subsequent events may have been a spontaneous fracture of a vertebra. From this time experienced frequency and incontinence of urine.

In 1932, severe abdominal pain was associated with increased disturbance of urination. Loss of weight and appetite. Cystoscopy revealed a vesical calculus and poor renal function. The calculus was removed by cystotomy. During convalescence routine blood studies showed a serum calcium of 13.93 milligrams and serum phosphorus of 2.98 milligrams with phosphatase of 3.4 units. The bones showed some decalcification by X-ray but no cystic areas.

Relief from abdominal pain followed the operation but increasing pain in thighs made worse by walking led to a second hospital entry for further study of her hyperparathyroidism.

May 24, 1933. Operation: A tumor was found adjacent to the left lower pole of the thyroid gland. It was roughly twenty times larger than a normal, inferior parathyroid on the right side. Pathology: Benign tumor of a parathyroid body.

Convalescence normal. No tetany.

June 1, 1933. Serum calcium 10.47 milligrams, serum phosphorus 3.85 milligrams.

July 22, 1933. Patient states that she has not felt so well for years. Gain of 12 pounds since operation.

Case 11. M.T., female, aged 53 years. During 1920–1923 had pain in legs and disturbance in gait. In 1929, a giant cell tumor of upper jaw was operated upon. Later a second tumor in nose was curetted. In 1930 fractured left forearm and left tibia from tripping on rug. Abdominal pain led to operation for replacement of uterus. Severe pains in legs continued. In 1931, X-ray films showed cystic tumor of right tibia. This was curetted. Completely invalided except for limited activity with crutches.

In 1933 severe pain in legs and lower back associated with spontaneous fracture neck of right femur. Diagnosis of osteitis fibrosa cystica at Cambridge

City Hospital. Transferred to Huntington Hospital where diagnosis was confirmed by Dr. Aub. X-ray films showed extensive decalcification and cyst formation of entire skeleton. Critically sick with respiratory distress, nausea, and vomiting. Serum calcium 13.7 milligrams, serum phosphorus 2.4 milligrams. Phosphatase elevated. Diminished renal function. Calcium deposits in kidney parenchyma.

June 20, 1933. Transferred to Massachusetts General Hospital.

June 24, 1933. Operation: Thyroid enlarged by nodular goiter. Substernal extension of right lower pole. Parathyroid tumor behind left upper pole. Subtotal resection leaving approximately 1 gram of tissue. Pathology: Specimen in two fragments, one 3 by 2 by 1 centimeters weighing 3.85 grams and one 2.1 by 1.1 by 0.8 centimeters weighing 1.2 grams. Benign tumor of parathyroid body.

Convalescent drop in serum calcium level as follows: pre-operative, 13.0 milligrams; June 25, 9.5 milligrams; June 26, 8.6 milligrams; June 27, 7.6 milligrams; June 29, 7.5 milligrams; June 30, 7.4 milligrams; August 28, 9.7 milligrams. Very mild tetany. Transient pyelitis. Second fracture of femur in changing traction apparatus.

September 4, 1933. Patient comfortable but bones show no evidence of increased density and fractures fail to develop callus. Extreme decalcification of skeleton being treated by high calcium diet, vitamin C, viosterol, and calcium glycerophosphate.

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HYPERTHYROIDISM AND ASSOCIATED DISEASES[1]

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SINCE hyperthyroidism involves all of the protoplasm of the body, so that all the tissues are stimulated to increased activity, one would suppose that diseases based upon increased activity of protoplasm would be more or less commonly associated with hyperthyroidism.

As the brain and central nervous system more than any other tissue are hyperactivated in hyperthyroidism, one would expect to find —and we do find—associated with hyperthyroidism most of the forms of mental and nervous diseases such as psychoses, neuroses, phobias, etc. When these conditions are due to the hyperthyroidism and not to some associated independent disease such as neurocirculatory asthenia they are relieved or cured by an adequate thyroidectomy except in cases in which delirium is present. The treatment when such nervous disturbances are due to neurocirculatory asthenia will be discussed later.

Of special importance are the cardiac lesions associated with hyperthyroidism the usual forms of which are tachycardia, myocardial decompensation, and sometimes auricular fibrillation.

Parry, in 1815, emphasized the importance of cardiac disturbances associated with thyroid disease, and this association was noted by Graves (1835), Basedow (1845), Stokes (1854), and Trousseau (1856). Kocher first pointed out that myocardial insufficiency associated with thyroid disease may be independent of any primary cardiac lesion and he noted a striking improvement in the cardiac symptoms following thyroidectomy.

The so called "thyroid heart" is one of the amazing phenomena of medicine, for a patient with an adenomatous or even a colloid goiter may exhibit a cardiac lesion which would be as certainly fatal as the same cardiac lesion under other conditions and yet the heart is restored by thyroidectomy.

Even angina may be associated with the presence of a goiter. According to Dr. A. C. Ernstene the presence of hyperthyroidism seems to bear the same relation to the production of anginal pain as does exertion in subjects with a normal metabolic rate. When such attacks occur the presence of some organic change in the heart must be assumed though such change may be relatively slight. In a case seen in 1912 in which I performed a right lobectomy and ligated the left superior thyroid artery, before the operation the patient had frequent attacks of precordial pain which was referred to the left shoulder and inner side of the left arm. Nitroglycerine gave considerable relief. The patient was followed for 7 years after the lobectomy and at no time was there any recurrence of the anginal attacks.

On the basis of the results of the procedure in 10 cases, Blumgart and his associates advocate total thyroidectomy even in the absence of obvious thyroid disease in cases of congestive heart failure or angina pectoris in which medical procedures have been ineffective. They report that subtotal thyroidectomy in 2 cases exerted a favorable influence on the cardiac disability.

The mechanism which associates a goiter with these cardiac lesions is not yet completely understood. Of one fact, however, we are perfectly certain, a fact which has been confirmed by the work of Emile Holman, Mont R. Reid, and others who have shown that arteriovenous aneurism causes dilatation and hypertrophy of the heart. In a case seen in association with the late Dr. C. F. Hoover and reported by him, that of a war veteran, an arteriovenous aneurism of the femoral vessels had caused a complete myocardial breakdown, with swollen extremities, ascites, enlarged liver, etc. This patient was completely cured by repair of the aneurism. In certain cases of goiter the vast increase in the vascular bed and in consequence a great increase in the work of the heart is obvious to the surgeon who sees in the thyroid a maelstrom of circulation—a vascular fury not approached in any

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other tissue or organ, equaled only by the circulation of an arteriovenous aneurism. It has been suggested that this great increase in the vascularity of the thyroid gland produces an arteriovenous shunt which if this were established would explain in part the "thyroid heart" which certainly in part at least is a simple effect of overwork, but it is not yet known how to apportion the effect of the increased vascular bed and that of the thyroid hormone. The effect of the latter is especially demonstrated in cases of adenomatous goiter in which cardiac manifestations may completely overshadow all the other symptoms of the goiter which may be so slight as to make it appear that the goiter is playing but a small part in the disease, as was the case in the patient with angina to whom I have referred. The Mayo and the Lahey Clinics have reported a series of cases of so called "thyroid heart."

Cardiac extrasystoles, paroxysmal tachycardia and paroxysmal auricular fibrillation may occur in patients with hyperthyroidism with about the same frequency as they appear in other patients of the same age group.

Dr. Ernstene has studied these cases and he concludes that cardiac arhythmias seldom occur in persons with normal hearts and rarely in patients under 40 years of age. In practically all patients above this age there is present some degree of hypertension or there may be changes in the coronary arteries. When auricular fibrillation is present, therefore, search must be made for some underlying cause which may have contributed to the arhythmia. Dr. Ernstene emphasizes the importance of examining all patients who have exhibited arhythmias at regular intervals for fear there may be a gradual progression of the underlying pathologic state.

Dr. John Phillips pointed out the significance of the changes in blood pressure which are seen in cases of hyperthyroidism. The blood pressure in toxic goiter resembles that seen in cases of aortic regurgitation, viz., an increased systolic pressure with a low diastolic, the pulse pressure being increased above the normal limit. Studies of the variations in blood pressure in goiter cases have been made by Plummer. This author found that 27 per cent of patients over 40 years of age who had non-hyperplastic goiter had a systolic blood pressure above 160. It is quite conceivable that a relatively slight overstimulation of the vasomotor mechanism from overactivity of the thyroid, if it persists over a period of years, may lead to an elevation of blood pressure or to permanent myocardial damage, which is manifested by auricular fibrillation, by paroxysmal tachycardia, or in some instances by cardiac decompensation. A series of follow-ups in our own cases showed no notable effect on the diastolic pressure.

Dr. Russell Haden has pointed out that, in hyperthyroidism, the blood plasma occasionally contains a low serum protein with a reversal of the albumin-globulin ratio. This is probably due to the low protein diets usually prescribed and to increased peristaltic action. If these changes are extensive enough to lower the osmotic pressure of blood plasma then œdema, ascites and pleural effusion may occur. This condition is relieved only by blood transfusion. In one case we performed 7 transfusions, drew off 7,500 cubic centimeters of fluid from the chest and abdomen and performed a thyroidectomy. The patient made a good recovery from the operation and from the disease.

We have seen one case in which subacute bacterial endocarditis was associated with hyperthyroidism. Other conditions which in association with hyperthyroidism may cause disturbances of the heart such as tachycardia, variation in pulse pressure, myocardial insufficiency, pericarditis, are endocarditis, chronic infection, and neurocirculatory asthenia, of which we shall speak in some detail later on. In these there is presented a complex picture, and the clinical results are indefinite and indeterminate.

In regard to treatment, the important dictum is that in any case of cardiac involvement in which hyperthyroidism is present the earlier thyroidectomy is performed the better for the heart.

Tuberculosis is a disease which must be considered in the differential diagnosis of hyperthyroidism and may be associated with this disease. During the past 10 years we have performed thyroidectomies in 87 patients who

had these two diseases with the following clinical results: In the cases in which the presence of pulmonary tuberculosis was definitely confirmed by X-ray examination, 74.5 per cent have shown definite clinical improvement following thyroidectomy. Of the cases in which we have been able to secure a postoperative roentgenogram, 82 per cent show improvement in the pulmonary lesions, while in 35 per cent the lesion has been cured.

Cutaneous manifestations are occasionally seen in hyperthyroidism; however, none is characteristic of this disease. Of especial interest among these is the occurrence of scleroderma. This disease is believed by many to be due to some alteration in the endocrine system but what that alteration is is not understood as the disease may be associated with hypothyroidism as well as with hyperthyroidism and as it may appear at the menopause. Erythromelalgia also may be associated with hyperthyroidism as may osteomalacia. Dr. E. W. Netherton includes a list of 22 forms of dermatosis which have been observed in cases of hyperthyroidism but as 16 of these were observed also in cases of hypothyroidism and 11 in cases of simple goiter it is evident that there is no direct relationship between these conditions and thyroid disease.

The *ocular changes* associated with hyperthyroidism are of interest but as they are among the classical symptoms of hyperthyroidism they have no proper place in this discussion except that it is interesting to note that in some cases exophthalmos does not respond to thyroidectomy. According to Dr. A. D. Ruedemann, in such cases the postoperative exophthalmos is usually due to hypothyroidism and thyroid extract is of benefit if given in large enough but controlled dosage. If the exophthalmos is persistently progressive it may be necessary to relieve the orbital pressure by Naffziger's operation.

The association of *joint abnormalities* with hyperthyroidism has been noted by various observers and Dr. J. A. Dickson and Dr. W. S. Duncan have observed 85 cases in our Clinic in which joint disease was apparently attributable to hyperthyroidism. Dr. Duncan says of these cases: "There could be no more gratifying or dramatic response than that which follows thyroidectomy. Almost invariably there is an extremely marked degree of improvement within from forty-eight to seventy-two hours after operation. . . ."

Of special importance in their association with hyperthyroidism are those diseases which bear a relation to hyperstimulation or abnormal activity of the adrenal sympathetic system—such diseases as diabetes, peptic ulcer, and neurocirculatory asthenia.

From a study of a particular series of 9,000 cases of hyperthyroidism seen at the Cleveland Clinic and from a study of the literature, Dr. Henry J. John found the incidence of *diabetes* in hyperthyroidism to be 2.31 per cent; while the incidence of hyperthyroidism in diabetes was 1.68 per cent. According to Joslin the incidence of diabetes in the United States is approximately 1,400,000, making a percentage of approximately 1 per cent. Dr. John made a special study of a series of 166 cases in which diabetes was associated with hyperthyroidism and found cure or abatement of the diabetes after thyroidectomy in 55 per cent. I am now trying to discover whether or not denervation of the adrenal glands will further contribute to the cure of diabetes and in 3 cases we have found that denervation apparently had a curative effect.

We have seen many cases in which hyperthyroidism has been associated with *peptic ulcer*. Peptic ulcer was present in 48 of 9,618 patients with hyperthyroidism seen at the Cleveland Clinic. Undoubtedly many cases have been overlooked as digestive disturbances are present in a large proportion of the cases of hyperthyroidism and if X-ray examinations had been made in all cases of hyperthyroidism the incidence of peptic ulcer would certainly have been much larger.

Peptic ulcer associated with hyperthyroidism may be relieved or cured by thyroidectomy. Like hyperthyroidism, peptic ulcer is relieved or cured by denervation of the adrenal glands. In the association of hyperthyroidism and peptic ulcer, if thyroidectomy does not cure, according to present indications, denervation may effect a cure of the ulcer.

Since hyperthyroidism itself presents a marked manifestation of instability of the

thyroid-adrenal-sympathetic system and since hyperthyroidism is caused by or at least influenced by a pathological overactivity of the adrenal sympathetic system, as is demonstrated by the abatement or cure of 19 cases of hyperthyroidism after denervation of the adrenal glands with no operation on the thyroid gland, it is not surprising to encounter cases in which symptoms of neurocirculatory asthenia accompany those of frank hyperthyroidism. In these cases the presence of neurocirculatory asthenia may not be recognized until after thyroidectomy when there will remain a residual pathological stimulation of the adrenal sympathetic system manifested by nervous tension, emotional instability, tachycardia and palpitation, tremors and sweating, in the presence of a normal metabolism. These hitherto intractable cases are cured by denervation. In such cases, while thyroidectomy may control the hyperthyroidism, it has no effect upon the neurocirculatory asthenia, but fortunately, neurocirculatory asthenia is cured by denervation of the adrenal glands as we have shown in a series of 83 cases in which complete or partial relief of symptoms was secured in 94 per cent of the cases of neurocirculatory asthenia uncomplicated by psychoneurosis—complete cure in 61 per cent, improvement in 33 per cent. Provided the presence of neurocirculatory asthenia is indicated in a case of hyperthyroidism, the operation of choice is denervation of the adrenal glands as this operation will ameliorate or cure not only the neurocirculatory asthenia but the hyperthyroidism as has been shown by our record of cures in 93.7 per cent of 48 cases of hyperthyroidism treated by adrenal denervation. If the primary operation is a thyroidectomy and residual symptoms suggest the presence of an element of neurocirculatory asthenia, then denervation of the adrenal glands should be performed.

SUMMARY

Hyperthyroidism affects every organ and tissue of the body inducing in each an increased activity. Other diseases due to hyperactivity of the thyroid, therefore, may be associated with hyperthyroidism. It would seem that the critical analysis of the accumulation of evidence is interpreting hyperthyroidism itself as an end-effect of a pathological stimulation—a pathological physiology of the adrenal sympathetic system—the system that occupies the driver's seat in the life and strife of civilized man. In those cases in which the pathological drive is more marked in a single gland or system, a single disease is wrought. In diabetes of the neurogenic type there is a pathological physiology of the pancreas; if the pathological drive bears most strongly on the pylorus, sphincterismus or peptic ulcer is the end-effect. If the pathological drive centers on the heart, intermittent tachycardia or other cardiac disturbances occur. If the pathological drive is still more general, neurocirculatory asthenia is the disease wrought; if the pathological drive centers especially on the thyroid, a hyperplastic, hyperactive thyroid with its bodywide activation is produced. If this interpretation is correct then this entire group of neurogenic diseases should be abated or cured by thyroidectomy when the disease is in the thyroid group, by denervation of the adrenals when the disease is in other groups, while in a small group both thyroidectomy and denervation should abate or cure the disease and that this is the case is now established.

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Discussion

Dr. H. M. RICHTER, Chicago: During the years that we have built up a clinical-pathological entity based on hyperplastic changes in the thyroid, we have consistently sought for the specific cause of the disease. We have considered the changes in the gland as essential to the clinical picture, but recognized that the cause of those changes probably lay outside of the gland. The literature of the past 30 years shows what a host of causes have at various times been considered responsible, including most consistently, the sympathetic nervous system.

Those of you who are familiar with Dr. Crile's work know that during the years, he has built up a working hypothesis based on an enormous amount of laboratory and clinical research. Tonight's paper correlates what he terms the "thyroid-sympathetic" and the "adrenal-sympathetic" systems. If the conception proves to be correct; if the "adrenal-sympathetic" system proves to be the control center of life's chemical and physiological processes, it will serve undoubtedly to enable us to approach the therapy of a great group of ailments from a new and more logical angle. It required a master of surgical technique, with the training of a physiologist to correlate the innumerable apparently unrelated clinical data and bring them under the invisible orderly rule of the controlling system. Dr. Crile's work serves to emphasize that in medicine as in all branches of science, the mastery of a few basic principles that become increasingly clear to us as they are subjected to intensive study, serves to untangle the maze of a thousand apparently unrelated facts, to bring order out of chaos. That the road of advance of medicine through the ages is strewn with the corpses of promising solutions of the various problems that confront us, keeps us critically conservative of all new advances. That we have advanced, that we have wonderfully advanced within the memory of the older members of this society, is due to such work, the reports of which we have listened to tonight.

Too many problems are raised by Dr. Crile to be covered in an evening's discussion.

I am not clear as to the significance of a "thyroid heart." The normal heart subjected to the unwonted exertion of mountain climbing, or thyrotoxicosis, shows signs of distress, and ultimately of damage under the stress of unaccustomed load. The heart previously damaged by rheumatism or syphilis gives way more quickly under the same circumstances. The immediate nature of the overload is beside the point. I am impressed by the comparison of the effect on the heart of the "maelstrom of circulation," the "vascular fury," phrases worthy of Dr. Crile, in the enormously vascular pathological thyroid, with that of an arteriovenous aneurysm. It suggests that the cardiac changes are not specific for thyrotoxicosis. The extra demands on the heart to meet the body's increased metabolic activity is, of course, also of the greatest importance.

I cannot believe that removal of a normal thyroid advocated by Blumgart to cut down the load on a damaged heart by reducing bodily metabolism as a whole is logical. The heart becomes hypothyroid as well as the rest of the organism, with less reserve to carry on.

If the drive on the thyroid is through an "adrenal-sympathetic" system, the very complete denervation of the thyroid after the suggestion of Jonnesco, made possible by the anatomic arrangement, would seem quite logical. The advances in technique and knowledge of the cervical sympathetic system may make that operation more successful than it was 30 years ago. Certainly it did not seem to stand up under the test of extensive surgical trial at that time.

Residual symptoms following an otherwise successful thyroidectomy form a disturbing problem to the surgeon. Many of these patients present rather simple problems, such as an overlooked hypothyroid state, with its accompanying anæmia and cardiac insufficiency. In my own work, I have regarded any postoperative persistence of thyrotoxicosis as evidence that I had left too much pathological thyroid behind; and in every case in which the patient permitted me to reopen the neck I have found that to be the case. But there is a residual group that is not so easily disposed of. If a malfunctioning adrenal sympathetic system is behind it all, Dr. Crile has substantially advanced our position in this field of medicine.

DR. LESTER R. DRAGSTEDT, Chicago: As has been so often the case in the past, Dr. Crile's paper tonight contains many new and indeed revolutionary ideas. His suggestion that a part of the cardiac difficulty in large vascular goiters may be accounted for as secondary to a disturbance in the circulation similar to that which obtains in arteriovenous aneurism is characteristically ingenious. The idea merits study and I should be most interested to learn if the increased venous pressure which apparently causes the difficulty in arteriovenous aneurism is also present in these goiter cases. However, it seems more probable, as Dr. Crile has suggested, that the major part of the functional cardiac pathology in Grave's disease is due directly to the effect of the increased amount of thyroid hormone in the blood or indirectly as a result of the increased metabolism produced by it. He has further commented upon the frequency with which diabetes and hyperthyroidism seem to be associated. In this connection

the recent demonstration by Houssay, and Barnes and Regan of the intimate relation between the anterior lobe of the hypophysis and pancreatic diabetes and the evidence for a thyreotropic hormone also obtained from the hypophysis are significant.

I regret to say on this occasion, however, that I am entirely unable to agree with Dr. Crile's logic and practice in denervating the adrenal glands for the treatment of ulcer of the stomach, hyperthyroidism, or neurocirculatory asthenia. So far as I know a successful denervation of the adrenal glands decreases or stops the output of adrenalin into the circulation and does nothing else. There is no evidence that the diseases under discussion are produced by an excessive secretion of adrenalin. They are not to my knowledge associated with an increased concentration of adrenalin in the blood and no one has produced them in experimental animals by the injection of adrenalin. It seems more probable to me in the light of the work of Aron, Okkels and Krogh, Loeb and Bassett, and others in which extracts of the anterior lobe of the hypophysis have been found to produce thyroid hyperplasia and an increase in the basal metabolic rate that of the internal secreting glands we should look upon hyperactivity of the anterior lobe of the hypophysis rather than the adrenal medulla as being more likely to be responsible for hyperthyroidism. I do not, advocate, however, hypophysectomy for hyperthyroidism. It is highly probable that in the very near future our knowledge of these interglandular relationships will become precise enough to furnish a basis for a more adequate therapy.

For a number of years I have been interested in the physiology of the parathyroid glands and for this reason perhaps this splendid contribution of Dr. Churchill and his associates at the Massachusetts General Hospital has an especially great appeal for me. A new clinical entity has been brought into view and again a successful therapy.

In these days of renewed activity on the part of antivivisectionists, it is perhaps well to recall that here again knowledge that makes possible the relief of human suffering has been obtained through previous work on the experimental animal. The successful isolation of the active principle of the parathyroid glands by Collip was soon followed by a demonstration of the metabolic derangement that follows its administration in excessive amounts. Skeletal changes resembling those of human osteitis fibrosa cystica were produced in rats and dogs by Jaffe and Bodansky and Johnson and Wilder and this paved the way for the recognition of the disease in man as probably due to hyperfunction of the parathyroids. However, allow me to emphasize that the carefully planned surgical exploration of the parathyroid glands in this series of cases in which a careful metabolic study had previously revealed chemical changes in the blood and urine exactly similar to those produced in the experimental animal by known hyperparathyroidism is one thing and the indiscriminate attack upon the glands in any patient who displays some abnormality in the skeleton is quite another. Surely after a century and more of progress, American surgery can do better than to mutilate the parathyroid glands of people with various bone and joint deformities in the blind hope that an occasional one may be benefited. We do not yet know the precise rôle played by the parathyroid glands in calcium metabolism and in the growth and maintenance of the skeleton. As Dr. Churchill has pointed out there is at present no scientific evidence which indicates that Paget's disease, and hypertrophic or ankylosing arthritis are due to hyperfunction of the parathyroids and until this is definite there is no justification for subjecting these patients to the dangers incident to parathyroidectomy. One must not be lulled to a sense of security in the thought that now that the parathyroid hormone is available, symptoms produced by parathyroid deficiency can easily be corrected. That is far from the case. Among the more serious of these symptoms are tetany and bilateral cataract. No one has to date prevented the development of cataracts after parathyroidectomy in experimental animals by any kind of treatment. Tetany may prove exceedingly difficult to treat and many cases after a time refuse to respond at all to parathyroid hormone injections.

MASTOPATHIA AND CHRONIC MASTITIS[1]

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THE female breast is perhaps the one organ in the body of common interest to the general surgeon, the physician, the gynecologist, and, perhaps I ought to add, the pediatrician. The problems associated with its physiology and pathology are such as to afford the strongest argument against the limitation of investigation within the narrow and often arbitrary confines of one branch of our science. The breast is essentially a sex organ and therefore its physiology and pathology should be the concern of the gynecologist; and had woman evolved on anatomical lines in the direction of the ungulates this statement would, I venture to suggest, not be open to criticism! As matters stand, however, the anatomical situation of the organ in the genus "Homo" has been the deciding factor in its relegation by many gynecologists to their general surgical colleagues.

The divorce of one sex gland from what Professor Blair Bell has termed the "sex complex" has not been without its disadvantages, and the recent work of the sex physiologists has shown the importance of including the breast and its functions as an integral part of the sexual chain. In other words there appears to be a strong argument for the inclusion of the mammary gland in the ambit of that rather ubiquitous individual the gynecologist, be he physician or surgeon!

My object in presenting this short communication upon so called "Chronic Mastitis" is again to focus attention upon the thesis that in this lesion we are dealing with the results of a disorder of function, and not primarily with an inflammatory condition. May I at this point pay tribute to the work of Dr. Max Cutler, of Chicago, and to that of Sir Lenthal Cheatle and Mr. Geoffrey Keynes, of London. The published observations of these workers have already thrown much light upon what has for many years been a difficult and much discussed subject.

THE PHYSIOLOGY OF THE BREAST

As a preliminary to the consideration of the pathological factors involved it is necessary to refer briefly to facts now available relating to physiological activity of the female breast. A. S. Parkes has pointed out that the development of the mammary glands may roughly be divided into four phases: (a) prepubertal, (b) pubertal, (c) ovulatory, (d) pregnancy. The prepubertal and pubertal stages are the result of stimulation by an ovarian hormone attributed by Steinach to the interstitial cells of the ovary. Estrus initiates further proliferation of the glandular elements, but full development and complete functional activity do not occur until pregnancy or pseudopregnancy intervenes. The essential factor in this final stage of mammary growth has been proved by Parkes and others to be the hormone of the corpus luteum. By prolonging the luteal phase in a non-pregnant rabbit with a sodium hydroxide extract of the anterior lobe pituitary, Parkes has produced complete mammary development and function.

In the human species the factors which underlie cyclical activity of the sex organs have in recent years been very completely investigated, and the basic principles are now generally accepted. In this natural sex rhythm the function of the mammary glands must be included. As long ago as 1878, Charles Creighton called attention to periodicity of function as an important characteristic of the mature breast. More recently Rosenburg, Polano, and Dieckmann have shown that during the monthly menstrual cycle the mammary epithelium undergoes regular progressive development and retrogression. From the time of ovulation and under the influence of the corpus luteum a rapid multiplication of epithelial elements takes place leading to the production of outgrowths from the ducts and the formation of small lobules. Secretion appears in the lumen of the smallest ducts, and indeed a *com-*

[1]Read before the Clinical Congress of the American College of Surgeons, Chicago, October 11, 1933.

parison may be drawn between the glandular elements of the premenstrual breast and the premenstrual uterine endometrium.

During the postmenstrual epoch many of these lobules disappear, the intralobular connective tissue shows œdema, and lymphocytes are a prominent feature in the periacinous areas. Owing to the presence of a laminated plug of keratinized epithelium in the ducts of the non-lactating organ, no escape of the products of monthly secretory activity is possible (G. Keynes). As Keynes points out the breast throughout life is a gland the cells of which possess a certain functional activity, and the difference between a lactating and a non-lactating but functioning organ is merely one of degree and chemical constitution of the secretion. Just as the menstrual function in the human species is now regarded as being in part the abortion of an unnecessary decidua, so must the premenstrual activity of the mammary glands be considered to be the manifestation of a pseudopregnant state induced by luteal activity. Inasmuch as the non-lactating breast has no outlet for its secretion this must be absorbed, and the products of epithelial disintegration removed by autolysis. The physiological balance between secretion and absorption is delicate, and when we remember the short and rapidly recurring sex cycles in woman, and the comparatively long intervals that occur between the periods of fully developed function—in some women not at all—is it surprising that deviations from normal function commonly arise?

Fig. 1. High power photomicrograph of mammary tissue during early premenstrual phase. At *A* and *B* are shown slight dilatation of acini resulting from secretory activity.

MAZOPLASIA

Anomalies in mammary activity occur either (1) as excessive epithelialization of individual acini, (2) as hypersecretion on the part of the mammary lobules, (3) in defective absorption and autolysis of the products of secretory activity.

Sir Lenthal Cheatle and Dr. Max Cutler in their monumental work entitled *Tumours of the Breast* refer at some length to the difficulty in distinguishing physiological from pathological processes in this organ. Under the term "mazoplasia" they describe a process of desquamative epithelial hyperplasia which they regard as being physiological in the sense that when it occurs apart from puberty or lactation, it merely represents an incomplete return to the physiological normal. There are certain features in connection with this so called state of "mazoplasia" which are deserving of detailed consideration. The histological picture as described by the authors is that of a hyperplasia of the epithelium of the terminal acini and smaller mammary ducts. The epithelium may be two or three layers in thickness and is in process of desquamation. The terminal ducts and lumina of the acini are filled with degenerated cells in process of autolysis, and such cells stain irregularly and poorly. The peri-acinous connective tissue is hyperplasic; lymphocytes are abundant and in close relation to the affected acini. The presence of lymphocytes is not an indication of inflammatory reaction. S. Bergel has shown that they contain a lipase, and that their function is associated with the digestion of fat and lecithin bodies. They are a necessary adjunct of the mechanism both of physiological and pathological autolysis.

The data which forced Cheatle and Cutler to the conclusion that mazoplasia is a physiological process are:

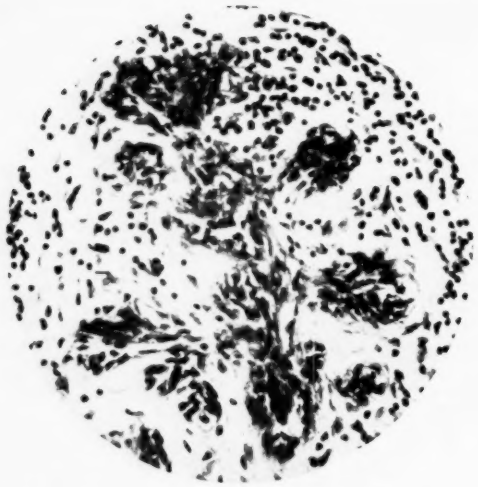

Fig. 2. High power photomicrograph of section of mammary tissue during early postmenstrual phase. Note the collapsed acini, some in process of disintegration. The peri-acinous tissue is œdematous and lymphocytic infiltration is marked.

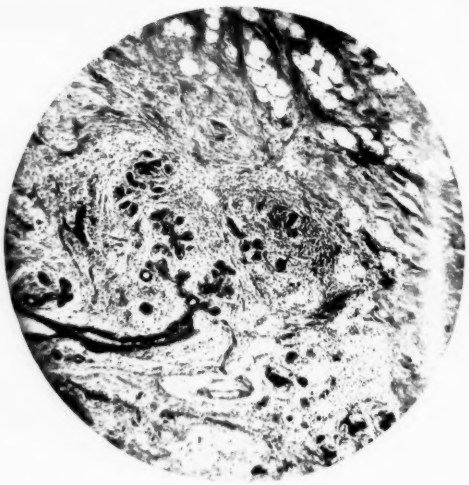

Fig. 3. A low power photomicrograph of a section from the same breast as in the preceding figure. The tissue shows numerous small acini with epithelium in the resting phase. Note the œdema of the peri-acinous connective tissue and the concentration of lymphocytes around the collapsed and disintegrating acini. The appearance of the tissue is entirely physiological.

1. That the clinical signs and histological appearance generally spontaneously disappear at the menopause.

2. That the condition can be found in the breasts of most women even when they have never complained of clinical symptoms.

3. That the same condition is present at puberty, and in male and female infants at birth. It is also present during pregnancy, and in the latent parts of the breast during lactation.

4. That no evidence can be brought forward of the transformation of mazoplasial hyperplasia into epithelial neoplasia.

The authors draw a sharp distinction between mazoplasia and cystic states of the breast, and express the view that the pathological condition variously described under the terms "Cystipherous Desquamative Epithelial Hyperplasia," "Chronic Cystic Mastitis," "Schimmelbusche's Disease," "Reclus' Disease," etc., is a clinical entity and in no respect related to the former.

CYSTIPHEROUS DESQUAMATIVE EPITHELIAL HYPERPLASIA

The reasons which Cheatle and Cutler adduce as sufficient justification for regarding the formation of cysts in the breast as a pathological entity are (a) that the process is entirely different in its biology and morphological appearance; (b) that in mazoplasia neither cysts nor papillomata are formed, and the epithelial hyperplasia remains stable; (c) that in cystipherous hyperplasia a change to epithelial neoplasia may occur, and that this transformation can be traced in all its stages; (d) that the cystipherous process is one of pathological activity.

In the earliest stage of the pathological type of desquamative hyperplasia the first change is elongation of the epithelial cells which later become cuboidal and pale in color. Proliferation occurs and three or four layers of cells are produced, some of which project into the individual acinus. Desquamation, the collection of fluid within the acinus, and blocking of the ducts, leads to retention of products and the formation of small cysts. In the desquamative process the epithelium of the smaller and terminal ducts takes part, and "colostrum-like" cells are produced and discharged into the lumen effectually sealing the ducts.

Fig. 4. Section of breast showing pathological appearance associated with mastopathia. The tissue was obtained from a breast during the premenstrual epoch and shows in an exaggerated form the changes incidental to this phase of the sex cycle. At *A* a few normal acini containing secretion are seen. At *C* cellular activity is more pronounced, with some distention of individual acini. Cellular proliferation is evident in the dilated acinus show at *D*. At *B* is seen a dilated small duct containing "colostrum corpuscles." Actual desquamation of the epithelium in the acini is not very evident and the small cysts are the result of excessive secretory activity on the part of the glandular epithelium producing a condition of local stagnation.

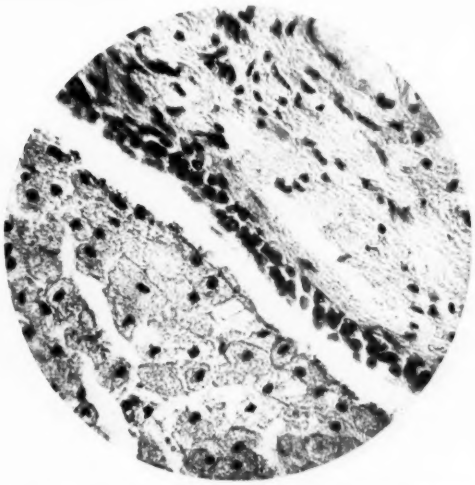

Fig. 5. High power photomicrograph of section of duct shown in Figure 4, showing intact epithelium (two layers) and a mass of "colostrum corpuscles" partially blocking the duct lumen.

MASTOPATHIA

Such, very briefly, is a summary of the present status of opinion on this difficult and controversial subject. On the one hand we have a large body of general surgeons who still consider "chronic mastitis" to be an inflammatory lesion, and commonly use the term whenever they meet with a painful breast, be it solid, "lumpy," or actually cystic. On the other hand, we have the writers who have introduced the terms "mazoplasia" and "cystipherous epithelial hyperplasia" definitely attempting to unravel the physiological from the pathological.

Now, I hope that I shall not be guilty of taking a retrograde step when I make the statement that I am not entirely satisfied that so called "mazoplasia" and "cystipherous hyperplasia" are two distinct conditions. Cheatle and Cutler bewail the fact that it is not possible "to describe all pathological states in chronological order of their occurrence and to demonstrate a definite sequence in their events." Professor Haswell Wilson of the University of Birmingham has kindly placed at my disposal the whole of the pathological material in his department classified under "chronic mastitis" and the opinions that I have formed after an investigation of this and my own material may be stated as follows:

1. That it is a matter of importance to correlate the microscopical appearance of the mammary acini and ducts with the period in the menstrual cycle when the material is obtained. Otherwise what is physiological may be regarded as pathological.

2. That abnormalities in the sexual rhythm should be carefully noted, as the same factors which cause irregularities in the menstrual function also produce a typical appearance in the breast epithelium.

3. That the condition described as "mazoplasia" is very commonly associated in the same organ with the lesion described as "cystipherous hyperplasia."

4. That in both lesions epithelial hyperplasia is the preliminary dominant factor, and that in both lesions the presence of the physi-

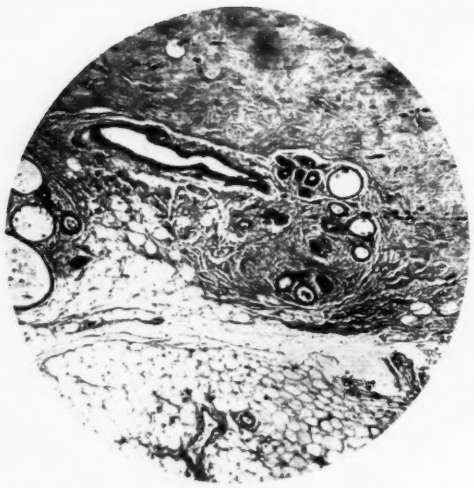

Fig. 6. A low power photomicrograph of a section from a breast the seat of mastopathia, showing the formation of cysts of distention. There is no evidence of desquamation but rather a progressive dilatation of the acini and smallest ducts as the result of hyperactivity. The appearance is comparable with that shown of the uterine endometrium under the influence of excessive stimulation of the sex hormone—an appearance formerly attributed to inflammation but now recognized as being due to a dysfunction.

Fig. 7. A high power photomicrograph of cyst formation in a case of mastopathia from the same section as in Figure 6. Note the transition from the high columnar epithelium in the acini *A* to the cubical and flattened epithelium at *B* and *C*—the result of increasing tension only. The cyst *B* contains secretion but no cellular detritus.

ological lymphocyte in large numbers is a constant factor.

5. That mazoplasia in the adult breast appears to be the natural result of *excessive* stimulation of the mammary epithelium by the luteal hormone.

6. That the result of *repeated* cyclical excessive stimulation of the mammary epithelium results in the production of excessive secretion and cystic disease. The formation of cysts merely appears to represent a breakdown in the normal balance between production and absorption.

7. Mazoplasia cannot be regarded as entirely physiological. It is physiological in the sense that it represents functional activity, but this activity is pathological and is an indicator of excessive zeal on the part of the physiological stimulus, either in amount or concentration.

8. The fluid from mammary cysts is quite definitely a secretion of the mammary epithelium. It also contains colostrum cells and epithelium in process of autolysis. It does not contain fibrin and it does not coagulate. Chemically some specimens show evidence of fat, and others contain urea and uric acid.

When considering these facts one not unnaturally comes to the conclusion as to whether there is sufficient justification to adopt the term "mazoplasia" merely to denote a failure on the part of the breast to return to the physiological base line. We cannot, at least I cannot, regard the process as physiological in that it is a disorder of function, and although common, yet pathological.

In the material that I have examined many sections show the appearance of mazoplasia without cystipherous hyperplasia but, and this to me is a very important point, I have not seen cystipherous hyperplasia from a breast which in some part does not also show mazoplasia. In some sections *the two conditions lie side by side*. Cheatle and Cutler explain this on the basis that "in married women between thirty and the menopause, mazoplasia is almost universal." Why then accord the condition the dignity of a special nomenclature?

Turning to the clinical aspect of the problem while a slight degree of premenstrual swelling and discomfort is a common phenomenon with many women, excessive tenderness and pain with generalized thickening calling for treatment, is not so frequent as one would expect if mazoplasia is a physiological state. The average age in a series of 20 painful nodular breasts in my own practice was 35 which compares favorably with the age of 34 years in the series published by Cutler. In the case of older women the symptoms had commonly been present for several years—in 2 as long as 8 years.

The condition is equally common in married and single women and all the patients in my married series were parous.

A clinical feature to which I desire to draw particular attention is *the association of the mammary symptoms with oligomenorrhœa*. Seventy per cent of the women in my series had scanty or very moderate menstrual lochia as compared with their menstrual function before breast symptoms developed. In Cutler's series the same fact is obvious, for in 10 of the 15 patients (66.6 per cent) he observes that the "flow is scanty." Another point of great interest to me is the *common association of menstrual headache* with full, painful breasts which call for treatment. One of my colleagues in England, Dr. A. P. Thomson, has investigated at some length the cause of menstrual headache, and concludes that it is the result of compression of the pituitary gland from a premenstrual swelling in a bony fossa with unyielding walls, and which not uncommonly is unduly small from excessive ossification.

The association of *oligomenorrhœa*, *menstrual headache*, and *mammary pain with swelling* is a syndrome in my opinion of considerable importance and provides the key to the breast symptoms. It is the anterior lobe of the pituitary to which we must look for the excessive luteinization of the ovary which is reflected in the production of the oligomenorrhœa and over-activity of the mammary epithelium. These painful nodular breasts to which the term "chronic mastitis" is so commonly and so wrongly applied, are in the first instance the result of excessive luteal stimulation. They are pathological in the sense that they represent a disorder of function. For this reason I venture to suggest the word "*mastopathia*" as an appropriate term to designate that stagnation of the mammary gland which results from a breakdown in the physiological intrinsic monthly drainage of the organ.

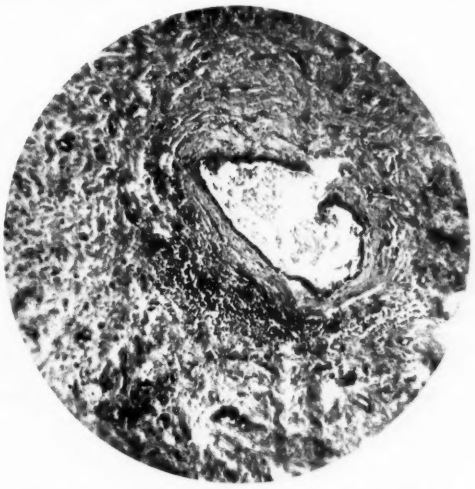

Fig. 8. Low power photomicrograph of a distended duct from a case of mastopathia. The epithelium is compressed but not desquamating. Lymphocytes are concentrated in the connective tissue immediately surrounding the cyst.

I do not propose in the present communication to discuss the possible results of this stagnation. Both excessive production and defective absorption of the breast secretion in the non-lactating organ I regard as factors of potential danger, and from the consideration of such material as I have studied I cannot dissociate from the pathological sequence of events the formation of cysts, and the serious changes which may follow cystic disease.

TREATMENT

If the thesis is correct that mastopathia is primarily a result of excessive lutein hormonic action initiated by the anterior lobe pituitary, then the aim of rational treatment should logically be inhibition of the hypophysis.

I believe that I am correct when I say that Dr. Max Cutler of Chicago was the first systematically to apply ovarian therapy for the

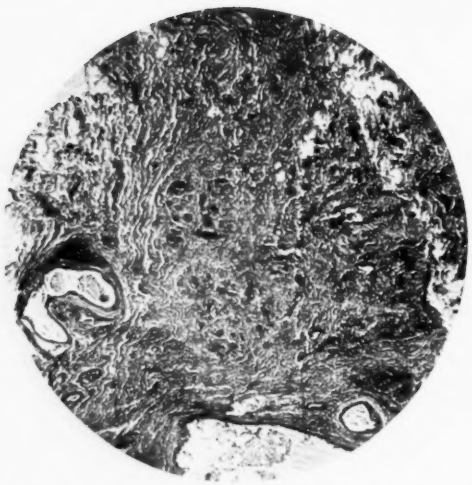

Fig. 9. Low power photomicrograph from section of breast the seat of advanced mastopathic change. The acini are atrophic, few in number, and separated by dense fibrous tissue. The ducts are permanently dilated to form cysts, and lymphocytic infiltration is absent. The appearance shown is the result of long repeated or irregular stimulation of the gland epithelium by the luteal hormone.

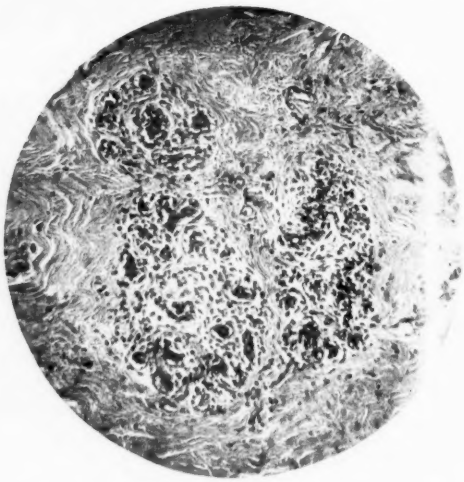

Fig. 10. High power photomicrograph from same section as in Figure 9 showing atrophic and degenerating acini separated by an excess of connective and fibrous tissue.

relief of mammary pain and swelling. Previous to his work scattered references only to endocrine therapy appear in the literature by Schweitzer, Bainbridge, Lisser and others. Cutler employed ovarian residue prepared from fresh animal ovaries not containing lutein tissue, and the results he obtained were remarkably successful. In 13 of 15 cases of painful breasts the symptoms disappeared or were markedly relieved.

I hope that I shall not be accused of "bringing coals to Newcastle" if I record a further series of 20 cases of the syndrome which I have termed "mastopathia" treated by the estrus producing hormone administered daily during the premenstrual phase. The preparation that I have used is theelin[1] and the results have been so uniformly good that I have reached the conclusion that we have available in the estrus hormone a therapeutic agent of great value in the treatment of disordered mammary function, whether we call it "mazoplasia" or "mastopathia." In 17 of 20 cases both pain and swelling of the breasts disappeared after a few months' treatment, although the effect was not always manifest after the first or second course of injections. In 2 cases actual cysts were present which were punctured and the contents aspirated, contrary to the usual and accepted practice of excision. Both these women are symptomless today, 12 months after the treatment, which is perhaps the best answer to the criticism that such practise naturally invites. The combination of cystic disease and mastopathia in these 2 patients, the response to treatment with theelin, and the non-recurrence of the disease affords, I think, some evidence of a common etiological factor. The 3 patients who did not respond to treatment with the estrus hormone were all women in the fourth decade of life in whom symptoms had been present for many years, and who only sought advice when the pain due to increasing intrinsic breast tension became unbearable.

[1]Prepared by Messrs. Parke Davis & Co.

CONCLUSIONS

The conclusions that I have the honor to submit for your consideration are briefly the following:

1. That so called "chronic mastitis" is essentially a disorder of function in the non-lactating mammary gland, and that the pathological appearance both of the epithelium and

stroma is the result of repeated cyclical overstimulation by the luteal hormone.

2. That the painful, nodular breast associated with irregular and scanty menstruation is a pathological entity the result of excessive luteal activity initiated by the anterior lobe pituitary, and which may appropriately be designated by the term "mastopathia."

3. That physiological intrinsic drainage of the mammary gland is a factor of prime importance and that periodic breast stagnation due to excessive secretion or defective absorption of the products of cyclical activity is a dangerous state, whether local or general.

4. That mastopathia may be relieved and the onset of mammary stagnation prevented by the use of the estrus producing hormone in sufficient quantity to counteract the activity of the corpus luteum.

5. That the term "chronic mastitis" should definitely and finally be relegated to the lumber-room of a discarded phraseology.

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Discussion

Dr. Max Cutler, Chicago: First, I should like to congratulate our distinguished speaker not only upon his clear and interesting exposition of a complex subject, but also upon his critical analysis and comprehensive interpretation of the important problems which he has discussed. I deeply appreciate the kind references Mr. Whitehouse has made to my studies and to the monograph which I had the honor to prepare in collaboration with my friend and colleague, Sir Lenthal Cheatle of London.

It is gratifying to hear the speaker re-emphasize the now accepted fact that in the lesion commonly designated as "chronic mastitis" we are dealing not with an inflammatory condition, but with a disorder of function. The objection to the use of the term "chronic mastitis" is not on the basis of accuracy in nomenclature. It is much more fundamental. The grouping together of lesions that are essentially physiological and therefore innocent with lesions that are distinctly pathological and definitely precancerous under a single term which implies an inflammatory state, has led to the greatest confusion in the interpretation of the clinical and pathological phases of breast diseases.

The only point upon which our views diverge from those of Mr. Whitehouse is that we have isolated a state of the breast erroneously called chronic mastitis and demonstrated it to represent not an inflammation but a disorder of function in order to unravel the physiological from the pathological. In doing so, as Mr. Whitehouse has pointed out, we have referred at length to the great difficulties of distinguishing physiological from pathological processes in this organ. Consequently, I appreciate thoroughly the point of view that the essayist has adopted. To illustrate the difficulties of interpreting biological phenomena from purely morphological studies, let us consider the observation quoted by Mr. Whitehouse, namely, that the two conditions, mazoplasia and cystic disease, often lie side by side in the same section. This fact we interpret as added evidence of the universality and hence physiological nature of mazoplasia. To Mr. Whitehouse this observation raises the question whether mazoplasia and cystic disease of the breast are separate and distinct conditions. Such are the differences occasioned by the limitations of the microscope and the inadequacy of morphological appearances to interpret biological and physiological phenomena. Thus at one extreme we witness an abnormality of the breast so closely allied to the normal that legitimate differences arise as to its physiological or pathological nature. At the other extreme we see cancer of the breast. Concerning the two extremes we possess considerable microscopical and some physiological data. Concerning the myriad of changes that occur in the interim we must confess almost complete ignorance.

Clinical, pathological, and experimental evidence combine to support the view that cancer is not a sudden event or accident in a previously healthy and normal tissue. On the contrary, exhaustive investigations seem to indicate that cancer is the end-result of a sequence of events which may have begun many years before the malignant state becomes evident either clinically or microscopically. In the breast there is conclusive evidence that at least 20 per cent of carcinomata have passed through the cystic and papillomatous stages.

It is not generally recognized that the most accurate and precise diagnostic methods for the early

detection of cancer today are relatively crude. The decisive and only morphological evidence upon which it may be asserted that a state of carcinoma exists depends upon the presence of living, multiplying epithelial cells in tissues which they have invaded and from which they can metastasize. It is, indeed, unfortunate that the state of our knowledge permits us to recognize that the state of carcinoma is present beyond all question only when the disease has reached this dangerous stage.

The thesis that cancer is the end-result of a consecutive and progressive series of events is fundamental not only from a practical therapeutic point of view but also etiologically. Are the cyclical changes in the breast epithelium governed by circulating hormones in any manner related to the formation of cysts, papillomata, and cancer? The evidence of Sir Lenthal Cheatle does not support this relationship. What factors determine whether a newly formed epithelial cell will desquamate and die or retain its viability, live, and multiply? Does the causative agent exert its initial influence upon the epithelium and continue to act uninterruptedly over long periods? To what extent do the products of secretion and decomposition within the confines of ducts and acini initiate or perpetuate the stimulus to benign and malignant neoplasia?

These are questions upon which information of a most interesting nature is becoming available. Perhaps the most significant of these researches emanate from the London Cancer Hospital where highly potent carcinogenic agents whose chemical structure is known have been prepared. The application of these findings may add information of great importance to this field of research which is most complex.

THE LIGATION OF LARGE ARTERIES[1]

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THROUGHOUT most of the recorded history of medicine, differences of opinion have existed concerning the best methods of controlling hæmorrhage. Since the beginning of the Christian era these differences of opinion have been mainly between the sponsors of the ligature and the advocates of the cautery, and this argument continues today. In the very early part of this era Galen, Celsus, Antyllus, Archigenes, and others seemed to have made headway toward the substitution of the use of the ligature for the crude and inhuman use of the actual cautery and of boiling oil. Throughout the dark ages the two latter procedures held almost complete sway. The use of the ligature, reintroduced by Paré, dominated all other forms of hæmostasis until modern times. Now, however, the refinements of cauterization and of cautery coagulation have begun again to make them competitors with the use of the ligature in dealing with hæmorrhage from small blood vessels. We should not be surprised if their use is extended into the domain of larger arteries.

From the time of Ambrose Paré until the establishment of the aseptic era of surgery, the ligation of large arteries was a very hazardous procedure. The dangers were especially accentuated when the scope of surgery was tremendously widened by the introduction of the use of anæsthesia. It is not necessary to recount to this audience the thrilling stories of battling with secondary hæmorrhage which abound in the surgical literature for nearly 50 years after Long's epochal demonstration of the anæsthetic value of ether in 1840. There was the watchman who assumed his duty about a week after the amputation of a leg, ready to apply pressure or a tourniquet when bleeding occurred. Reamputations because of secondary hæmorrhage were a common procedure.

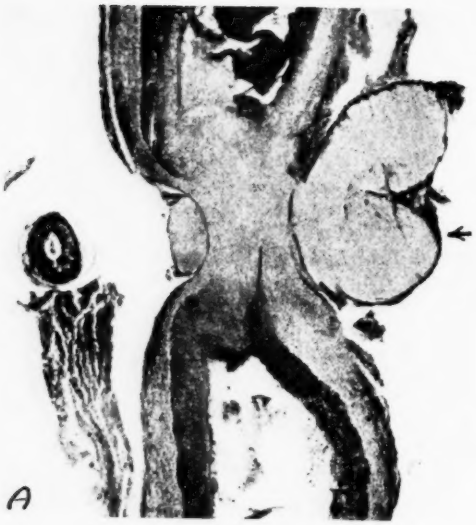
Modern asepsis and the advances that have been made by Carrel, Dakin, and others in the antiseptic treatment of contaminated and infected wounds make it advisable to discuss the ligation of large arteries under two headings: (1) the aseptic ligation of large arteries and (2) the ligation of large arteries in the presence of actual infection or in contaminated wounds.

The aseptic ligation of large arteries. Contrary to the general belief there are still many dangers associated with the aseptic ligation of large arteries. The field of vascular surgery has been extended to include even the aorta. While asepsis has largely eliminated the dangers of hæmorrhage and restoration of the lumen after ligation of any of the large peripheral arteries, nevertheless these two dangers must still be borne in mind when one is dealing with the large arteries of the trunk and neck, or with abnormally dilated and thin walled peripheral arteries. In order to discuss in detail some of the subjects I wish to present, it will be necessary to review briefly the fundamental principles underlying the healing of a ligated artery.

Ballance and Edmunds in 1891 made an enduring contribution to the subject. Based upon the belief that the vessel beneath a ligature may remain viable and that the intimal surfaces would unite if brought together gently over a sufficiently wide area, they advocated a method which must still be considered perfectly sound. In particular, they advocated the use of double heavy ligatures which should be tied sufficiently tight to approximate intimal surfaces but not tight enough to fracture the arterial wall.

Without in any way changing the value of the practical principles advocated by Ballance and Edmunds, Halsted and Reid in 1916 showed that the partial or complete occlusion of a large artery resulted in an anæmic necrosis of the segment of vessel included in the ligature or band. They doubted if intimal union ever occurred and expressed the view that the ultimate result of the ligation of any large artery was directly dependent upon the rapidity of necrosis of the segment of ligated vessel and the rapidity of substitution of this nec-

[1] Presented before the Clinical Congress of the American College of Surgeons, Chicago, October 9–13, 1933.



A.

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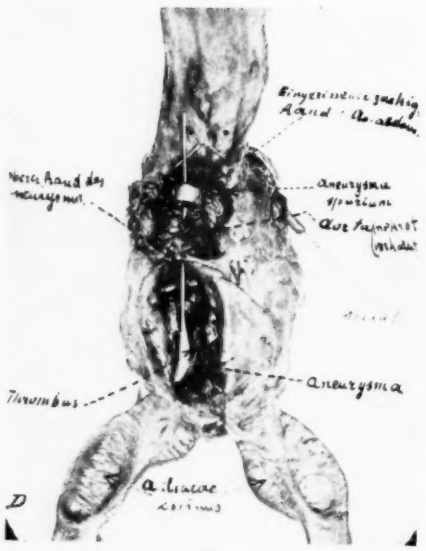

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Fig. 1. Illustrations of the necrosing and cutting effects of ligatures and bands upon the arterial wall. A, "The effect of a ligature on the arterial wall (Horsley, Jr.)." B, The effect of a transfixion suture, *A*, on the side of an artery (Reid). C, The effect of an aluminum band on an artery, *a*, site of band that has cut through; *e*, new wall of fibrous tissue outside of band (Halsted and Reid). D, Photograph of a human specimen, showing a partially constricting aluminum band which cut through the a[illegible]ta 6 weeks after its application, with fatal hæmor[illegible]age. (Photograph sent by Kocher to Halsted.) E, "Re-[illegible]tab-lishment of the lumen of the aorta in the dog, foll[illegible]ing ligation with a fine silk ligature (Halsted)." F, Six m[illegible]ths after partial constriction of the aorta in the dog [illegible] an aluminum band (Halsted and Reid).

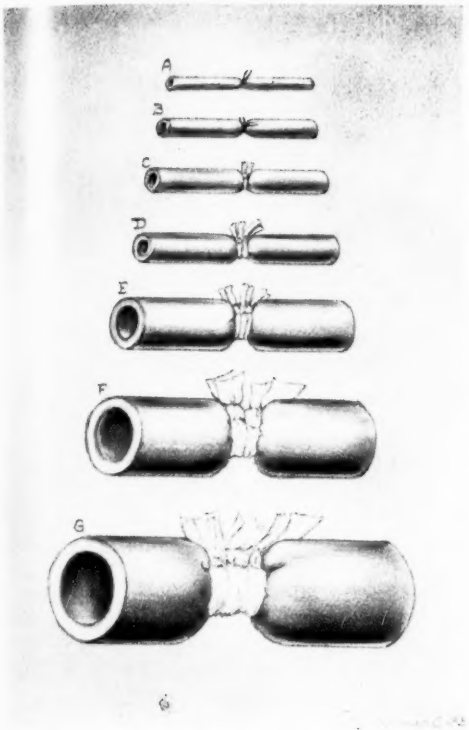

Fig. 2. Diagrammatic illustration of the variation in size of the ligature when ligating normal arteries of different calibers. *A*, Radial artery, one strand of medium silk. *B*, Brachial artery, two strands of medium silk. *C*, Axillary artery, one strand of braided silk. *D*, Subclavian, common carotid, popliteal, and femoral arteries, two strands of braided silk. *E*, Innominate and external iliac arteries, three strands of braided silk. *F*, Common iliac artery, two strands of tape. *G*, Aorta, three strands of tape.

rotic segment by scar tissue. The conclusions drawn from this changed view of the process of healing following the ligation of an artery are essentially stated in the principles enunciated by Ballance and Edmunds—namely, permanent occlusion will be more likely if a wide segment of vessel is included in the ligature or band, and also if the ligature or band is applied in such a way as to cause the least mechanical damage or fracture of the arterial wall. In this way the process of necrosis will be the slowest and the chances of its complete substitution by scar tissue will be the greatest.

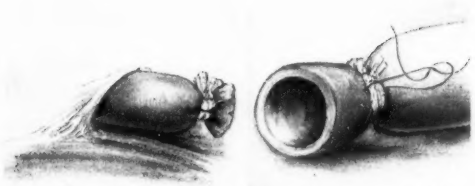

Fig. 3. Large ligatures of a divided artery may be anchored *in situ* by a small transfixion suture of black silk. Not advised when there is infection.

In the aseptic ligation of a large artery three things may happen. First, the necrosis may be so rapid that the ligature will cut through and permit the restoration of the lumen. In such cases sufficient healing occurs outside of the ligature to prevent the occurrence of hæmorrhage. Recently we had the opportunity of examining at autopsy a patient in whom the right subclavian and carotid arteries had been completely occluded by ligatures of chromic catgut 3 years previously because of an aneurism of the innominate artery. The lumina of both vessels had been restored and there was only the slightest scarring of the vessel walls at the sites of the previous ligations. I could cite several instances in which a partial restoration of the lumen has occurred. In such cases the harsh systolic bruit which is always present over a partially occluded large artery can be heard with the stethoscope. At present we are much interested in watching the course of a young boy who has developed a partial restoration of the lumen of the carotid artery following its ligation with an aluminum band for an intracranial arteriovenous aneurism.

Second, the occluding ligature or band may result in such rapid necrosis of the segment of vessel that there will occur a rupture of the vessel with massive hæmorrhage. Hæmorrhage frequently follows partial or complete ligation of the human aorta and very often the bleeding is fatal. In dealing with this largest human artery the intravascular tension is so great that the rate of necrosis beneath the ligature is markedly accelerated. Except in a few cases, notably those of Matas, Brooks, and Vaughan, the ligation of the human aorta has been followed by a re-establishment of its lumen or by hæmorrhage or by both. The

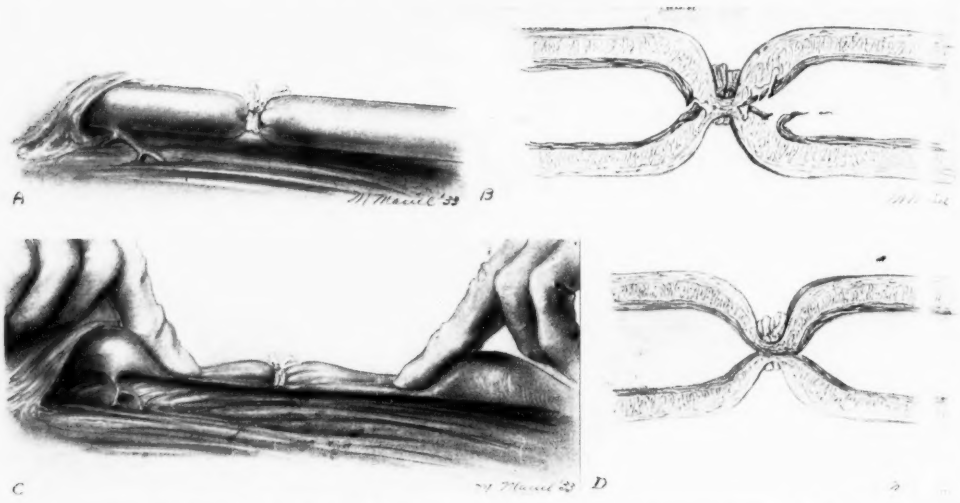

Fig. 4. Ligation of a large artery before and after release of the intravascular tension. In A the ligature is drawn tight while the artery is fully distended and pulsating, showing in B the frequent effect of rupturing the arterial coats. In C the tension is released before tying the ligature, showing in D the coats of the vessel not ruptured.

danger of hæmorrhage following aseptic ligation is, however, not limited to the aorta. In my report of the aneurisms admitted to the Johns Hopkins Hospital, a case of fatal hæmorrhage following banding of the common carotid artery is reported. F. Kammerer (cited by W. S. Halsted) reported a case of fatal hæmorrhage after ligating the left subclavian artery with chromacized catgut. In my own experience there have occurred two instances of rather extensive hæmatomata following ligation of the femoral artery. In both cases the artery was enormously dilated and thin walled as a result of an arteriovenous aneurism. In each case the artery was ligated with double, heavy braided silk. Both patients recovered without infection. Recently in our own clinic, a very large splenic artery was ligated with one strand of black medium silk in the process of performing a splenectomy. The splenic pedicle was perfectly dry at the completion of the operation. The wound was closed without drainage. The next day the patient had a fatal intra-abdominal hæmorrhage, which almost certainly occurred at the site of the ligation of the artery with one small strand of silk. We are all familiar with the results of the attempts at gradual occlusion of the aorta by means of the adjustable clamp that protrudes through the abdominal wall. The bad results in such cases may have been due in part to the complication of an infection.

Third, the total or partial occlusion may become permanent as desired only when the segment of vessel made avascular by the ligature becomes completely substituted by scar tissue. In dealing with the normal arteries of the extremities, under aseptic conditions, the complete occlusion is almost uniformly obtained by any of the accepted methods of ligating arteries. When, however, the ligation must be performed upon larger arteries or upon dilated and diseased peripheral vessels the dangers of hæmorrhage and the re-establishment of the lumen still constitute an important problem. I think it is safe to say that partial ligation of a large artery never maintains the same degree of occlusion for a very long period of time. As a result of thrombosis and its organization, complete occlusion is frequently the final result. But when complete occlusion does not occur the segment of anæmic arterial wall atrophies and thus results in an enlargement of the lumen, the extent of which depends upon the kind of ligating material used. As has already been

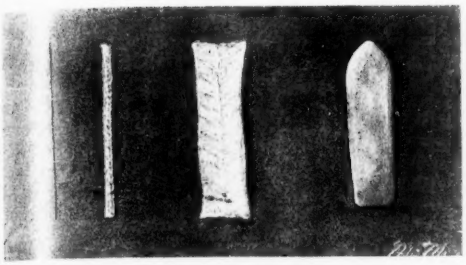

Fig. 5. Medium black silk, braided white silk, tape, and aluminum band used for occluding arteries.

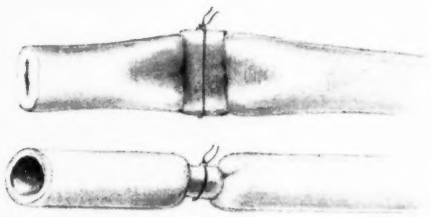

Fig. 6. The gently flattened and removable aluminum band as advised by Matas. The rolled band of Halsted. The author uses the ligatures to prevent uncoiling.

pointed out, the danger of hæmorrhage after partial ligation is just as great or perhaps even greater than that after complete ligation of a large artery.

With this understanding of the effects of aseptic ligatures upon an arterial wall and of the possible results, it is permissible to draw some conclusions which appear to me to be fundamentally sound.

In general, the size of the ligating material should increase in direct proportion to the size of the artery to be ligated. In other words, the segment of vessel included in a ligature should bear a direct relation to the diameter of the lumen of the vessel. (Although based on different premises this conclusion does not fundamentally differ from the procedure of ligating large arteries advocated by Ballance and Edmunds.) It seems definitely established that a small, fine ligature about a large artery allows a much shorter period for repair of the devitalized segment than does a large ligature or a piece of tape and therefore favors the occurrence of hæmorrhage or a re-establishment of the lumen. In this connection I should like to quote from Ballance and Edmunds' monograph on "Ligation in Continuity."

> Wyeth says the tension of the ligature to such a degree as to divide the inner or middle coat, or both, is unnecessary. I have tied arteries (carotid and subclavian) in human beings and in horses and dogs, and have specimens which demonstrate successful occlusion of the vessel without division of either of the three tunics. Scarpa advanced this idea years ago, but surgeons generally have decried it. None the less it is true, and I am fully convinced by experience that it is safer than the division of one or two coats of a vessel by tightly drawing a narrow cutting ligature around the artery.

The surgeon who has had the experience of cutting the human aorta or some smaller, strongly pulsating artery in two when pulling a ligature tight has a keen appreciation of the dangers of fracturing the arterial wall. Even if this has not happened it is safe to say that most of us are familiar with that unpleasant crunching sensation which one experiences when the ligature causes a rupture of the media of the vessel wall. This all too frequent effect of the ligature undoubtedly introduces an element of hazard into the procedure since the tremendous intra-arterial tension makes its occurrence extremely difficult to avoid. The desirability of avoiding this immediate effect of the ligature has been emphasized by Matas, Ballance and Edmunds, and Makins and is beginning to be appreciated by most surgeons. To avoid this danger I have for several years practiced the temporary proximal occlusion (sometimes both proximally and distally) of a large artery during the procedure of tying the ligature. After thus removing the intra-arterial tension I have not experienced the sensation of rupturing an artery by the tying of a ligature. The ligature can be pulled down as smoothly and as easily as when ligating a vein or connective tissue. It is well known that the sudden give of a ruptured media often results in the tying of a ligature too tightly. By first removing the intra-arterial tension the ligature may be tied with just sufficient tension to occlude the lumen and at the same time without any danger of rupturing the media or of cutting the vessel in two.

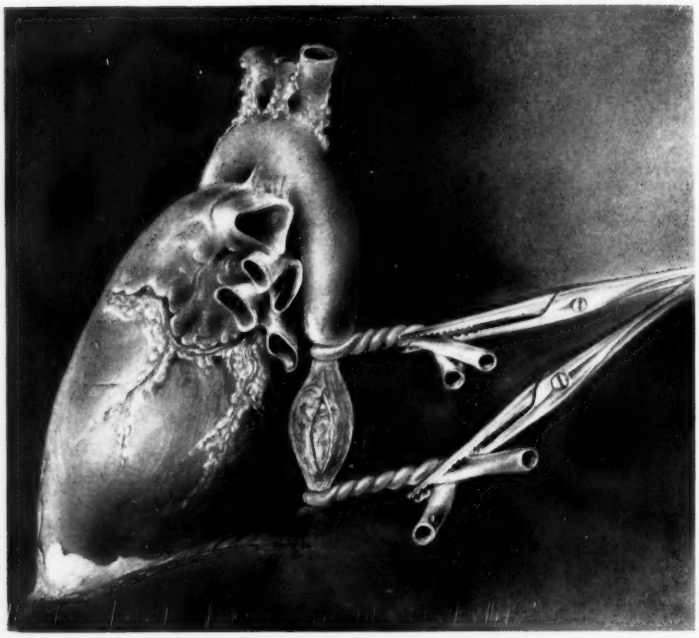

Fig. 7A.

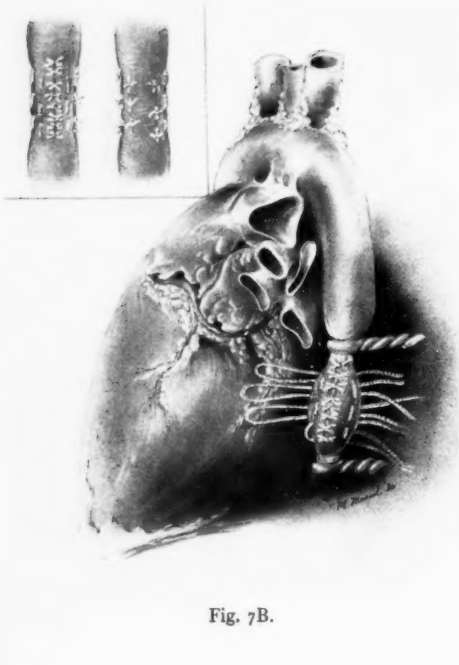

Fig. 7B.

Fig. 7. Occlusion of the human aorta by means of an anchored fascial plug. A, Illustration showing the thoracic aorta temporarily occluded by rubber tubing, and the fascial plug in place ready to be sutured. B, Occlusion of the thoracic aorta by means of the anchored fascial plug. The incision into the aorta has been sutured. The through-and-through mattress sutures of silk are ready to be tied. The insert shows the anterior and posterior views of the completed operation.

Another logical conclusion is that the ligature material should not be subject to stretching or dissolution by the tissue juices, for such material may very likely, as in Kammerer's case, allow the full force of arterial blood to be exerted on a segment of necrotic arterial wall before sufficient repair has taken place to withstand this force. For this reason the use of catgut for the ligation of large arteries must be considered as dangerous. The materials that seem most likely to keep the ligated segment of vessel in a stationary state for substitution by scar tissue are silk, linen, fascia and aluminum bands.

When a large artery is occluded with the definite knowledge that there will never be any need to restore its lumen, it is always advise

policy to divide it. The retracted ends lessen materially the dangers of hæmorrhage and obviate entirely the possibility of a restoration of the lumen. In some instances it has seemed advisable to anchor ligatures by means of transfixion sutures as shown in the illustration. This precaution prevents the slipping of a ligature and certainly obviates the danger of having it blown off the end of a divided large artery.

Only very little attention has been paid to the effect of ligation and resection of a segment of a large peripheral artery upon the innervation of that artery or upon the peripheral vasomotor disturbances that frequently result from such a procedure. Considerable difference of opinion exists as to the true cause of the marked peripheral vasodilatation which follows the resection of even a small portion of a major artery. Kramer and Todd demonstrated a definite segmental distribution of the nerves to the arteries which tended to put this phenomena in the class of a reflex mechanism rather than a direct action upon peripherally coursing fibers in the adventitia of the artery. Recently, however, the work of Albert has thrown new light upon the mechanism of the active vasodilatation which follows the resection of a major artery. It was concluded that the vasomotor response does not depend upon the cerebrospinal reflexes or upon the long sympathetic reflexes. By comparison of the studies of Albert with similar ones of Krogh and of Thomas Lewis, it appeared that the vasomotor reaction was largely due to the physiochemical modifications of the composition of the blood in the periphery and of the interstitial liquids of the affected parts as a result of the distended cellular metabolism brought about by the arterial obliteration. Albert believes that specific substances are produced or are accumulated in the peripheral part of the extremity as a result of such a disturbed metabolism and that these substances act directly upon the walls of the small arteries and capillaries and provoke the vasomotor reaction. The ultra-filtrate of blood recovered from an extremity showing marked peripheral vasomotor disturbances was injected into an animal and a marked peripheral vasodilatation occurred immediately. In the recent work of Pearse no mention is made of the advantages of arteriectomy over arteriotomy in cases of embolic occlusion of major arteries of the extremities. In considering the problem of the ligation of large peripheral arteries this question of the vasomotor response must be borne in mind since the establishment of a collateral circulation about an acutely occluded major artery may depend entirely upon the amount of peripheral vasodilatation that is present. All factors which tend to bring about peripheral vasoconstriction must be avoided if an adequate collateral circulation is to establish itself in the face of an obliteration of the major arterial pathway of that extremity.

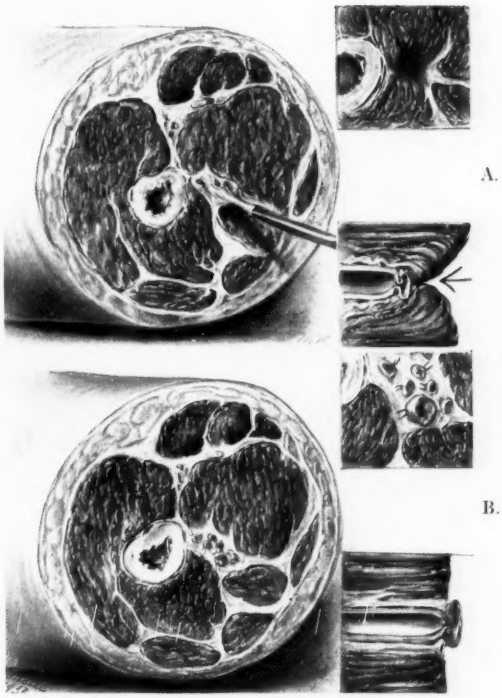

Fig. 8. Illustrating the old and a new method of dealing with large vessels when performing a guillotine amputation. A, A common practice of stretching and ligating vessels so that they will retract far into the tissues. The inserts show the inaccessibility and dangers of the infection. Secondary hæmorrhage is more likely to occur. B, The procedure advised. The entire wound may be treated with Dakin's or some other antiseptic solution, especially the ligatures on the large vessels.

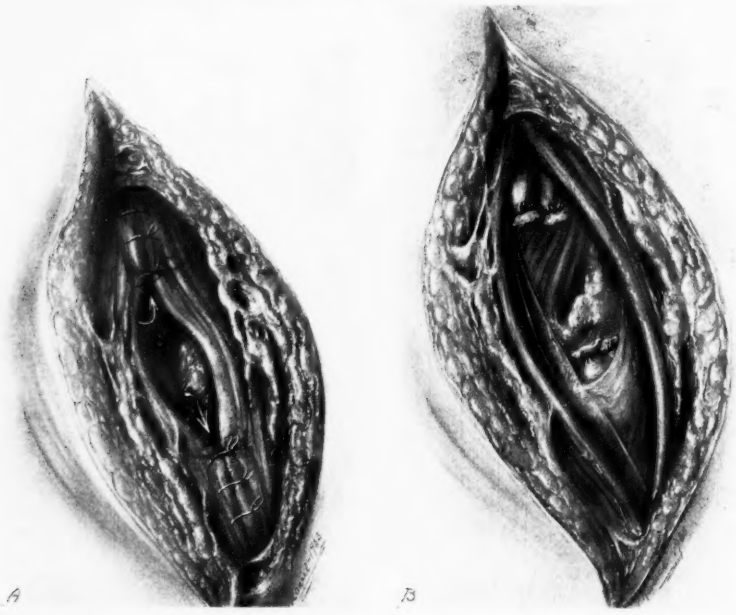

Fig. 9. Ligation of large vessels in infected wounds. In A the stumps of the vessels are ill-advisedly covered by sutures in the muscles. Infection is difficult of control; secondary hæmorrhage is more frequent. The author advises leaving the vessels exposed as in B.

The possibility of desiring to restore the lumen of an artery must always be borne in mind when ligating the common or internal carotid arteries and frequently when ligating large peripheral vessels, especially the brachial and popliteal arteries. Under such circumstances the occlusion is made by the aluminum or metallic band which should be rolled very loosely at first and then flattened with extreme gentleness, as advocated by Matas. In this way the viability of the included segment may be preserved for several days and, if the effects demand it, the band may be removed at any time during that period. Due to the looseness of such bands I have usually tied a ligature of silk about them in order to maintain accurately the desired degree of occlusion which might, otherwise, change as a result of uncoiling of the band.

With all these precautions the ligation of the human aorta or of a tremendously dilated and thin walled peripheral artery remains a dangerous procedure because of the possibility of massive hæmorrhage. In an effort to avoid this danger we have on several occasions opened the vessel and occluded it by means of a large fascial plug anchored within its lumen. This procedure has previously been reported and is again illustrated in this paper.

The ligation of large arteries in the presence of contaminated or infected wounds is attended primarily by an increase of the danger of secondary hæmorrhage. Due to the certain intravascular clotting a restoration of the lumen practically never occurs. On the other hand, the infection hastens the dissolution of the ligated and devitalized segment of vessel; if severe, it usually causes a liquefaction of the clot formation, and it retards the processes of repair. Consequently hæmorrhage occurs much more frequently.

Except in degree the fundamental processes of necrosis and repair are unchanged. However, there exists the general impression that the infection requires a change in the kind of ligature material and that the presence of a

very large artery makes it necessary to deviate from the accepted methods of dealing with infected wounds. Generally the fixed, non-absorbable ligature is discarded in favor of the variable and absorbable catgut ligature. It is my belief that the demand for an unyielding and constant ligature of a large artery is tremendously increased by the infection which causes a more rapid dissolution of the necrotic segment of vessel and a lessened rate of repair. The fixed ligature gives the best chance for repair and it prolongs the period before the devitalized segment of vessel will be subjected to the entire intravascular pressure. It is granted that the non-absorbable ligature may have to be removed or allowed to discharge spontaneously, but this is of minor importance if, as has been our experience, the danger of secondary hæmorrhage can be eliminated.

There also exists the general feeling that ligated large arteries must, in some way, be covered by fascia or muscle rather than be left exposed on the surface of an infected wound. In fact, this procedure is strongly advised in many of our textbooks of surgery. When one reflects that this procedure not only puts more foreign material in the form of sutures into the wound but also makes the infection about the vital ligature upon the artery inaccessible to antiseptic treatment one wonders how the procedure has become so fixed in the minds of most of our colleagues. It is probably a hang-over from the period just prior to the recent rebirth of faith in the antiseptic treatment of infected wounds. Routine is often responsible for practices that are no longer reasonable. For example, I have become completely discouraged in an effort to teach nurses that every patient returned to the ward from the operating room does not require treatment for shock. In order to prevent the cruel sweating, it is now the duty of some member of the operating team to go to the ward to remove hot blankets and hot water bottles from around the patient. Similarly it has become a routine with surgeons not to leave a large artery exposed in an infected wound. It is a common practice to pull on vessels and ligate them under tension, during amputation, so that the ends will retract far into their sheaths for protection. It is evident that the vessel cannot be covered over with infected tissues without increasing the severity of the infection about it. It is evident, also, that drainage is less free and that the ligated vessel is less accessible to antiseptic treatment. It has become our practice to make sure that ligatured large arteries in cases of infected wounds are left freely exposed for drainage and to frequent irrigations with Dakin's or some other antiseptic solution. Not infrequently wounds so treated heal completely with the silk ligatures remaining in them. In one case the wound became infected following excision of a large femoral arteriovenous aneurism. It was immediately opened down to the four ligatures on the ends of the vessels. Following thorough dakinization the wound was again closed. It has remained healed for 5 years without the silk sutures causing any trouble.

During the World War one of the fundamental principles in the sterilization of wounds was to have all infected parts of the wound freely accessible to the antiseptic solutions. The same principle holds in civil practice even when the wound contains a ligatured large artery. Secondary hæmorrhage will be lessened; frequently, secondary closure can be performed.

SUMMARY

By way of summary I will quote from W. S. Halsted. He says: "Let the surgeon who is about to ligate a large artery bear in mind the following facts:

"1. Fine ligatures cut through the arterial wall more rapidly than coarse ones.

"2. Partially occluding ligatures and crushing ligatures are dangerous.

"3. Absorbable ligatures may disintegrate unevenly, and thus a coarse ligature be reduced to a fine one; or the knot may slip and thus convert a total into a partial occlusion.

"4. Intimal surfaces brought in contact cannot unite because the wall of the artery becomes necrotic under the coarcting ligature.

"5. The necrosed wall under ideal conditions becomes converted into fibrous tissue, into a solid cord by the in-growth of blood vessels from the ends.

"6. Under certain conditions, for example when the lumen has not been totally occluded,

or the wall of the artery has been too severely crushed, hæmorrhage may be prevented by the formation of a fibrous tissue capsule enveloping the ligature and the arterial defect. Moderately coarse ligatures may, without causing leakage of blood, cut their way through an artery ligated in continuity. In the wake of such a slowly cutting ligature, a partially obturating diaphragm is likely to form. There may be several crescentic-like diaphragms, their free concave edges bounding the lumen which remains.

"7. A coarser ligature should be used in tying an artery in continuity than for occluding the ends of a divided one.

"8. It is probably safer, when feasible, to divide an artery, tying off the ends, than to ligate it in continuity.

"9. Catgut ligatures should not be employed, lest some strands be absorbed or loosened before the others, and it is probably inadvisable to tie with a bundle of threads of any kind. It is decidedly risky to apply—as has been recommended and practised—a partially coarcting ligature central to the totally occluding one, for the arterial wall eventually giving way as it must under the former, it is only by the formation of an enveloping fibrous tissue capsule or by repair in the wake of the cutting thread that fatal hæmorrhage is prevented. For the ligation in continuity of large arteries I have been using narrow tape.

"10. The wound should be closed without drainage, and completely.

"11. If infected, the wound should be promptly and freely opened and treated by the Carrel method with an antiseptic solution which will not endanger the devitalized wall of the artery under the ligature."

CONCLUSIONS

To these "facts" of Halsted I would add the following conclusions.

1. When ligating large arteries less damage will be done to the arterial wall if the vessel is temporarily occluded, proximally (and distally), during the procedure of pulling the ligature tight.

2. The size of the ligature should vary directly with the size of the artery.

3. A method of anchoring ligatures on the end of a divided artery, in a sterile wound, is described.

4. Ligated large arteries should not be covered or buried in an infected wound. They should be accessible to the most scrupulous antiseptic treatment.

5. The presence of an infection does not justify the use of catgut for the ligation of large arteries. On the contrary, it makes more mandatory the use of an unyielding material, such as silk, tape, or the metallic band.

6. For the temporary occlusion of a large artery the Matas-Allen flattened metallic band is best. It should be used whenever there is the remotest chance that it may be desirable to restore the lumen of an occluded vessel.

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THROMBO-ANGIITIS OBLITERANS[1]

Buerger's Disease

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THE first description of thrombo-angiitis obliterans was made by Friedlaender, in 1873, who introduced the term "arteritis obliterans." In 1879 von Winiwarter described pathological changes in several cases of presenile gangrene, especially emphasizing the proliferation of the intima; he introduced the term "endarteritis obliterans." Isolated examples of this disease have been reported as "obliterating arteritis." Still another name used to describe this condition is "juvenile gangrene." The first clear cut presentation of this form of arteritis was made by Buerger (11), who, in 1908, made a comprehensive report of the clinical and pathological aspects of the disease. He introduced the term "thrombo-angiitis obliterans." The term fulfills the requirements of pathological terminology and has been adopted generally. Buerger's contribution was complete from the clinical and pathological aspects. Little of importance has been added concerning these phases of the disease since his original report. In the past decade the contributions to knowledge of thrombo-angiitis obliterans have largely dealt with incidence, racial distribution, and medical and surgical treatment.

ETIOLOGY

The foreign literature attests to the fact that thrombo-angiitis obliterans is widely distributed; persons of practically all races have been affected. It was first believed that the disease was largely confined to Jews. This error probably arose because the clientele of the early investigators of the disease was largely Jewish. It is of fairly frequent occurrence among Orientals. The racial distribution indicates that the incidence is high among Jews, but all other races are subject to the disease with the exception, as far as I know, of full blood negroes.

All workers have agreed that the disease is practically limited to males. However, Horton and I (20) recently have reported 11 cases in which the patients were females; the proportion of females in experience at The Mayo Clinic, has been less than 2 per cent. The explanation of the predilection for males is unknown. It brings up many interesting questions as to possible etiology.

The cause of thrombo-angiitis obliterans is not known. Two main theories are current at present, one of which is that infection and the resulting toxins together compose one cause. This theory was advanced by Buerger (12), and is held by workers at The Mayo Clinic. Buerger was able to reproduce the pathological lesions in man by implantation of resected, inflamed, superficial veins. Horton and Dorsey have carried out similar successful studies by implantation in the femoral veins of rabbits of resected segments of superficial veins that were the seat of phlebitis. Bacteriological studies have not been conclusive. Several organisms have been described, but none has fulfilled the postulates of Koch. There is much to be said in favor of the idea that infection and toxins are causative. The lesion in the tissue of the vessels is inflammatory in nature. The progression and relapses of the disease in the affected vessels suggest inflammation of low grade.

The second theory is that tobacco is related to the cause and to the course of the disease. Meyer and Silbert (34) have held the view that tobacco is the primary etiological agent. Barker (5) has shown that 91.5 per cent of patients who had thrombo-angiitis obliterans used cigarettes, as against 56 per cent of a control group of subjects of similar age and sex. Of perhaps greater significance, he showed that patients who used tobacco little or none had less severe lesions than did patients who were excessive users of tobacco. On the other hand, I have observed a group of patients with thrombo-angiitis obliterans who have never used tobacco in any form. Maddock and

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Coller have demonstrated that smoking of cigarettes has fairly constant vasoconstrictor effects, as measured by the fall in surface temperature of the digits. Barker (7) has confirmed this observation and has shown that normal persons and patients with thrombo-angiitis obliterans responded in the same degree. Sulzberger and Harkavy, Hebald and Silbert determined the hypersensitivity to tobacco extracts of the skin of patients with thrombo-angiitis obliterans. They reported that hypersensitivity of patients could be graded 77 to 89 per cent, whereas hypersensitivity of normal subjects could be graded 10 to 36 per cent. Nicotine seems excluded as a factor.

Although this work on etiology is important, much remains to be explained. It is difficult to ascribe the gross pathological reactions of the blood vessels to allergy. The similarity of the pathological lesion to that produced by ergot in the fowl has been noted by Kaunitz.

PATHOLOGY

The pathological changes in the vessels in thrombo-angiitis obliterans have been carefully described by Buerger (12), Todyo, Mahorner (10), and others. Inflammatory arteritis is present, at times acute, but often subacute. All layers of the arteries and veins are infiltrated with leucocytes and lymphocytes. There is active proliferation of the intima, with subsequent deposition of a red thrombus containing leucocytes and lymphocytes. Organization of the thrombus occurs by infiltration with fibroblasts and gradual disappearance of the hæmoglobin. Giant cells are present. Grossly, the arteries, veins, and nerves are enmeshed in an inflammatory, fibrous mass. Small portions of the arteries and veins undergo closure, organization and canalization, and collateral circulation develops. After variable periods of time similar events take place in other segments of the vessels. In the healed, quiescent stage, the occluding thrombus is seen to have become canalized, and circulation thus partially restored. In the nerves may be found the pathological changes of inflammatory and degenerative neuritis. The disease has a predilection for the extremities, and tends to attack the arteries and veins of small and medium size.

Arteries involved. The arteries of the leg were involved in 74 per cent of 389 cases observed from 1928 to 1932. The arteries of the leg and arm were involved in 24 per cent. The arteries of the arm alone, in 2 per cent. These data are based on the presence or absence of pulsation in the usual palpable arteries, the ulnar and radial arteries in the wrist, and the dorsalis pedis, posterior tibial, popliteal, and femoral arteries in the leg. Allen's studies on arteriography, employing thorotrast, indicate that the digital arteries are involved in more cases than is apparent from the figures above.

Involvement of the deeper veins occurs much less frequently than does involvement of the superficial veins and the arteries, thus explaining the absence of œdema in the ordinary type of case. Œdema of the foot in the presence of gangrene may result from keeping the foot constantly in a dependent position. Involvement of other arteries than those of the extremities is rare. Several cases have been reported of inflammatory arteritis of the coronary arteries. I have observed a case of this. Similar lesions have been described but rarely, as has been said, in the brain and in the renal arteries.

Superficial phlebitis. Superficial phlebitis (Fig. 1) has been present on the original examination in 15 per cent of all patients with thrombo-angiitis obliterans who have come to The Mayo Clinic. In addition, 29 per cent have given a valid history of this condition. The total incidence, therefore, is 44 per cent.

CLINICAL GROUPING

There are five common clinical types:

Compensated type. Usually, in this type, the disease is of long duration, trophic changes have not occurred, and adequate collateral circulation has developed. The sole symptom may be mild claudication, or fatigue on exercise of the muscles of the foot or leg. In this type the segmental occlusion has been relatively slow, relapses none or few, and collateral circulation has kept pace with the obstructing process. Probably 10 per cent of the patients seen at The Mayo Clinic fall into this category.

Slowly progressive type. In this type there are periods of arterial closure, with symptoms and signs of arterial insufficiency of distal parts, such as reduced temperatures of the affected extremity, then gradual improvement, followed by relapses. Patients have been observed, who have had a series of relapses and periods of gradual improvement for 10 or 15 years, but at no time, ulceration or gangrene. The collateral circulation has kept pace with the occlusive process

Type in which gangrene is limited. This type is accompanied by trophic ulcers of the digits, with rest-pain during the active stage of ulceration. There is marked tendency to healing, with frequent relapses. Again, the collateral circulation is sufficient to prevent massive breakdown of the tissues and secondary infection. In this type of case the ulcers are frequently induced by mild trauma, by application of irritating antiseptic substances, or by unnecessary surgical interference with the digits.

Acute progressive type. In this type, within a few months, large segments of the arteries undergo closure. Frequently the condition is bilateral. Progression is rapid, tolerance to exercise is lessened, and trophic ulcers, frank gangrene, and excessive pain develop.

Extreme type. Frank, massive gangrene is present in this type. It is the end stage of the three preceding types.

Other types. In addition to these five usual types, there are others that are more unusual. There is the symptomless type in which an artery of an extremity is occluded, with absolutely no symptoms suggesting arterial insufficiency; more than one artery may be occluded. There is a type in which severe pain is the outstanding feature, in the absence of any ulceration or gangrene. In addition to pain, there are numbness, burning, and other forms of paræsthesia, and at times sensory and motor changes. This type is recognized as ischæmic neuritis, usually complicating closure of the femoral arteries. In a type occasionally observed, there is excessive ulceration and gangrene without pain. The explanation for this is not clear, but the personal factor of perception of pain may explain it in part.

ANALYSIS OF SYMPTOMS

The symptoms which may occur following obstruction of the arteries can be grouped as follows: (1) Impairment of the arterial blood supply to the distal parts results in lowered surface temperature, claudication, and muscular atrophy. (2) Small ulcers, dry or moist, are found most frequently in the margin of the nails, or frank ulceration, gangrene, and secondary infection; the pain is constant, in contradistinction to that of claudication, which comes with exercise. The growth of nails is impaired, and the skin may be thickened, dry, and fissured and abnormal calluses may form. (3) Local inflammation of the arteries and veins, phlebitis or arteritis, when superficial may cause the surrounding tissues to be red and tender to touch; distress is brought on by movement or pressure. (4) Ischæmic neuritis causes the severe pain characteristic of neuritis; it frequently is paroxysmal, and usually is worse at night. (5) Vasospastic disturbances resulting from sensory vasomotor reflexes, initiated by the irritative lesion in the arteries, causes blanching and cyanosis, and a numb, dull, aching sensation, on exposure to warmth. The frequent occurrence of these spastic phenomena in thrombo-angiitis obliterans has been the cause of many erroneous diagnoses of Raynaud's disease being made in cases in which the patients were males (3); most of the patients who have Raynaud's disease are females.

A TYPICAL CASE

A man, Gentile, aged 37 years, came to The Mayo Clinic because of pain in the foot on walking. He had smoked two packages of cigarettes a day for 15 years. Three years previously he had noted that the right foot became colder than the left. In addition, during cold weather, the affected foot felt numb, and blanching of the toes was observed on several occasions. A year later he had found that after walking for three blocks a painful sensation of fatigue developed in the arch of the right foot. Six months later a similar sensation had been noted in the calf of the same leg. He had found that by resting 2 or 3 minutes, relief supervened and the same exercise could be repeated. In the year before his visit to the clinic the amount of walking he was able to do had been reduced to approximately one block, and in the recent past similar symptoms had been noted in the left foot. He had noted repeatedly red spots along the veins of the right leg; these cleared in 2 weeks.

Six weeks before his admission to the clinic a small ulcer, associated with constant pain had developed on the nail-margin of the right first toe and had not healed. He also stated that in the preceding winter he had noted that several fingers of the left hand were extremely sensitive to cold, and that blanching had occurred.

On examination, the right foot, when dependent, was much redder than the left. When elevated, the foot blanched sharply, and when dropped slowly to the dependent position, at least 1 minute elapsed before normal color returned and the veins filled. Palpation disclosed perceptible difference in temperature of the 2 feet. The arteries of the right leg below the femoral artery, and of the right leg below the popliteal artery, had become closed. In addition, the left ulnar artery was occluded, and the fourth and fifth fingers were colder than the other fingers. Allen's (2) test was positive in the left hand.

Study of this case revealed clearly the various steps which took place in the course of this occlusive disease of the arteries and veins. With claudication of a foot there must be closure of the arteries as high as the popliteal artery. When claudication in the calf developed, the popliteal and lower portions of the femoral arteries were closed. With this amount of arterial occlusion, trophic ulcers are prone to occur and pain is present even when the patient is at rest. In the case reported, the red, inflamed cutaneous spots which disappeared after several weeks, and then reappeared later, were visual evidence of superficial, relapsing, nodular phlebitis. More frequently evidence of phlebitis is observed, such as linear streaks which progress either upward or downward. The segments affected may be from 1 to 4 or 5 inches (2.5 to 10 or 12.5 centimeters) in length. This process in the vein is a visual demonstration of a similar process occurring in the arteries. The vasospastic symptoms in the fingers and absent pulsation in the ulnar arteries, indicated that the disease had invaded the arteries of the upper extremities.

CRITERIA FOR DIAGNOSIS

Certain characteristic diagnostic features are available in this disease: (1) Ninety-eight per cent of the patients are males. (2) The ages of patients seen at the clinic has varied from 17 to 79 years, with the average age 42 years. Seventy-two per cent of the patients were between the ages of 30 and 49 years. (3) The predilection for Jews has been considered in the section on etiology. In the clinic, from 1928 to 1932, 28 per cent of the patients with thrombo-angiitis obliterans were Jews and 72 per cent were Gentiles. In an earlier series the ratio was 55 per cent Jews and 45 per cent Gentiles. (4) Excessive use of tobacco seems to have some relation to the disease. (5) The disease tends to affect first one extremity, then the other; probably in more than 90 per cent of cases the condition eventually is bilateral and in a high percentage of cases the hands or fingers are involved as well.

The most frequent errors in diagnosis consist in mistaking the claudication in the foot for evidence of arthritis or fallen arches, and the abnormal rubor of the toes for evidences of infection. The pain in the arch of the foot on exercise suggests a structural defect in the bony support, and most patients have had three or more pairs of arch supports. At least 20 per cent of the patients who have come to the clinic with gangrene have had incisions made or nails removed for supposed infections of the digits. The presence of superficial phlebitis, in a male, if spontaneous, should lead one to suspect thrombo-angiitis obliterans. If the palpable arteries are open, the patient should be treated as if he had an early form of the disease.

The essential point to establish in the presence of symptoms referable to the hands, feet or legs, is whether the complaint is due to disease of the vessels, and if it is, whether the process is occlusive or vasomotor. A clinical classification of circulatory diseases of extremities is given in Table I. The distinction between occlusion and vasomotor disturbances can be made with accuracy in 95 per cent of the cases by determining by simple palpation, the presence or absence of pulsations in the four palpable arteries of the leg, or in the two palpable arteries of the wrist. If occlusion is present there is more than a 90 per cent chance that the condition is thrombo-angiitis obliterans or arteriosclerosis with thrombosis. The necessity for distinction between these two conditions is, of course, more or less academic, since the problems of treatment are, with certain well defined exceptions, alike. If

TABLE I.—TENTATIVE CLINICAL CLASSIFICATION OF ARTERIAL VASCULAR DISEASE

Functional or vasomotor types	Local distribution	Vasoconstricting type	*Raynaud's disease*
		Vasodilating type	*Erythromelalgia*
	General distribution	Vasoconstricting types	Primary or essential hypertension; early stages
		Vasodilating types	Primary or essential hypotension
Organic types	Local distribution	1. *Arteriosclerosis obliterans:*	Senile gangrene; diabetic gangrene
		2. *Thrombo-angiitis obliterans*	
		3. Simple thrombosis: embolism	
		4. Arteriovenous communications (congenital, acquired)	
		5. Aneurysm with or without thrombosis	
	General distribution	*Arteriosclerosis*	
		1. Primary	
		2. Secondary types due to hypertension	

the patient is less than 50 years of age, if one artery of an extremity is occluded, or more than one, if superficial phlebitis has been or is present, and if symptoms or signs of arterial insufficiency exist, a diagnosis of thrombo-angiitis obliterans can be made. The difficulty is in the distinction between thrombo-angiitis obliterans and arteriosclerosis obliterans when the patient is between the ages of 50 and 60 years. If a patient is in the sixth decade of life, if he gives a short history of circulatory disturbance of the extremities, if the arteries of the lower extremities are closed and those of the arms open, if there is no evidence or history of phlebitis, if evidence of arteriosclerotic disease of the retinal arterioles can be found, and if demonstrable grades of calcification of the peripheral arteries are shown in roentgenograms, the diagnosis of arteriosclerosis is valid. I have found closure of the arteries of the arm in less than 1 per cent of cases of arteriosclerosis. As previously has been stated, the necessity for distinguishing between these two important occlusive diseases is not crucial, as far as diagnosis is concerned.

I would emphasize again the diagnostic importance of the symptom of claudication and of the determination of pulsation in the palpable arteries. No complicated instruments of precision are necessary to allow fulfillment of these clinical requirements.

TABLE II.—NEUROVASCULAR (ARTERIAL) DISTURBANCES OF EXTREMITIES (1,118 CASES)

Disturbance	Cases	Per cent	Total per cent
Occlusive disturbances			
Thrombo-angiitis obliterans	372	46.8	
Arteriosclerosis with occlusion	292	36.7	
Arteriosclerosis with diabetic gangrene	73	9.4	
Occlusion from embolus	22	2.7	
Simple gangrene	8	1.0	
Aneurysm with thrombosis	4	0.5	
Cervical rib with thrombosis	1	0.1	
Unclassifiable	23	2.8	71.1
Congenital disturbances			
Arteriovenous fistulas (congenital and acquired)	40	58.8	
Congenital anomalies	3	4.4	
Trophic ulcer (nonvenous)	25	36.8	6.0
Vasomotor disturbances			
Vasoconstrictor disorders			
Raynaud's disease	97	43.7	
Typical with scleroderma	21	9.5	
Typical with arthritis	9	4.0	
Primary vasospastic disturbances	27	12.2	
Secondary vasospastic disturbances	41	18.4	
Indeterminate forms	27	12.2	19.8
Vasodilating disorders			
Erythromelalgia	8	24.2	
Other vasodilating disturbances	25	75.8	2.9

FREQUENCY OF CIRCULATORY DISEASES OF THE EXTREMITIES

The diagnoses made in 1,118 cases of circulatory disturbances of the extremities are recorded in Table II. As will be observed in this table, thrombo-angiitis obliterans accounted for approximately 47 per cent of the 795 cases of occlusive arterial disease, and arteriosclerosis with occlusion, with and without diabetes, for approximately 46 per cent. The incidence of other occlusive diseases was small.

SPECIAL STUDIES

For those especially interested in more refined methods of study, the following procedures are useful in evaluating effects of treatment and in securing more accurate information about the associated vasomotor factor.

Measurements of surface temperature. This is relatively simple and can be carried out as a routine. There are three types of instruments. The thermocouple employs the constant temperature junction, galvanometer, and temperature scale. This is accurate to a fraction of a degree centigrade, and has the advantage that a different thermocouple can be attached to each of different digits, and readings can be taken rapidly. The portable type, such as the dermotherm, based on the same principle, is compact. It has the disadvantage of having a single thermocouple junction. The glass thermometer with a flat mercury bulb and a protecting rubber collar is sufficiently accurate for clinical purposes. Surface temperatures, to be comparable, must be determined under comparable room temperatures, for the surface circulation of the skin is responsive to changes in environmental temperature. The usual range of control room temperatures should be from 24 to 26 degrees C.

Oscillometry. The Paschon oscillometer is used to determine the magnitude of pulsations of the arteries. Simpson has shown that in using this instrument, a standard technique should be employed, because variations in application of the cuff may give erroneous information. When carried out by accurate, comparable technique, effects of treatment can be evaluated.

The vasospastic element. One of the advances in the study of diseases of the peripheral blood vessels has been the recognition that in addition to the occlusive arteritis, there may be an associated vasospastic disturbance (8). This is frequently detected by the attacks of blanching and cyanosis of digits following exposure to cold. In other cases of thrombo-angiitis obliterans, the surface temperature is abnormally low but increases with elevation of environmental temperature. These vasomotor reactions are exaggerations of what occurs in the normal subject. The quantitative estimation of this vasospastic factor has a practical application in selection of suitable cases for sympathetic ganglionectomy. The method used at The Mayo Clinic is as follows: In cases of thromboangiitis obliterans, fever is induced by injection of foreign protein (Lederle's triple typhoid vaccine) intravenously. Surface temperatures of the digits and temperatures of the mouth are taken every 30 minutes. If the surface temperature of the involved digits increases at least twice that of the temperature of the mouth, it is considered that a fairly high degree of vasoconstriction in addition to the occlusion, is present. This ratio I have designated as the vasomotor index. The rise in mouth temperature is deducted from the rise in skin temperature to obtain the net rise in surface temperature attributable to vasodilation.

The vasomotor range. This value is simply the increase, with fever, in degrees centigrade in the surface temperature of the affected digit. When this increase is 4 degrees or more, an excessive degree of vasospasm is believed to exist.

The maximal vasodilation level. If a temperature of at least 29 degrees C. is attained in the skin of the affected digits after induced fever, satisfactory ability for vasodilation is assumed to exist. Studies after sympathetic ganglionectomy indicate that the amount of vasodilation can be predicted before operation with considerable accuracy. Morton and Scott, and White have obtained similar information by the use of general, spinal or regional anæsthesia. Their work also indicates the high value of these pre-operative studies. Various methods employing the vasodilating effect of high environmental temperatures have been suggested by Lewis. Ethyl alcohol given by mouth, acetylcholine, and theobromine, also produce vasodilation of the peripheral arteries but not of sufficient degree to make these drugs useful from the prognostic standpoint, although they are useful in treatment.

Calorimetry. The Stewart-Kegerreis calorimeter has distinct usefulness in measuring indirectly the volume flow of blood through an extremity (9). The vasodilating effects of sympathectomy and other therapeutic measures are accurately determined.

Arteriography. Injection of the arteries of the limb with thorotrast has been a recent development. This substance is 25 per cent thorium dioxide in colloidal state. It was

introduced by Radt and Oka for visualization of the liver and spleen. Allen and Camp have investigated the peripheral circulation by this method. It gives highly valuable information in cases in which distinction between vasomotor and occlusive lesions is otherwise impossible. In cases of thrombo-angiitis obliterans in which lesions are confined to the palmar and digital arteries, decisive visual data are obtained (Fig. 2).

Fig. 1. Nodular and linear superficial phlebitis. Trophic changes of the nails are evident.

TREATMENT

Prophylactic measures. These measures require diagnosis of the disease in the stage before ulcers or gangrene have occurred. If the diagnosis is made at this early stage, subsequent ulceration or gangrene can be prevented in the majority of cases; the patient becomes aware of the nature of his disease and learns to treat his extremities with care, avoiding trauma and unnecessary wear and tear.

When instructing patients in the early, or compensated, stage of the disease, several measures are emphasized. Trauma should be avoided. Excessive walking and exposure to cold should be guarded against. Great care should be exercised in trimming the nails. The application of medicaments of an irritating nature should be sedulously avoided (Fig. 3). The danger of the patient's contracting the widespread trichophytosis (ringworm, or athlete's foot) should be recognized, and proper treatment should be given early, if the disease appears. The shoes should be changed frequently, and soft woolen hose should be worn in cold weather or during sleep if necessary. Great precautions must be exercised by patients whose occupations entail trauma. This necessity is thoroughly explained to the patient. I am of the opinion that in the cases in which ulcers or gangrene have appeared, half of these lesions could have been prevented had the patients been cognizant of the impairment of the blood supply.

Measures to increase the circulation. Simple measures can be carried out by the patient without undue sacrifice of time or money. Postural exercises, as outlined by Buerger, are useful in the stage before trophic changes appear. The hands or feet are kept elevated for 1 minute, or until pallor is present; for at least 1 minute, or until color has returned, they are kept in the dependent position; for 1 or 2 minutes they are kept in the horizontal position. This exercise can be repeated ten or fifteen times, for one or more sessions daily. The procedure has a rational basis, and patients frequently attest to its efficacy in the early stages of the disease. The extremities may be warmed by exposing them to temperatures, produced by radiant heat, of from 100 to 120 degrees F.; 1 or 2 ordinary carbon light bulbs are employed and the baking apparatus is adequately ventilated. The possibility of burning the extremities must be constantly kept in mind. Covering the toes with a soft towel may be necessary. The length of exposure to the heat is gradually increased to perhaps 2 or 3 hours each day. Contrast baths are useful in the absence of gangrene. The extremities can be submerged to the knee or the elbow, in cold water at a temperature of from 40 to 50 degrees F., and then in water at a temperature of from 100 to 110 degrees F. The extremities are alternately immersed in the hot and the cold water for 1 minute at a time. The alternate immersion is repeated ten or fifteen times, ending with immersion in the warm water. Under such treatment, the peripheral vessels alternately contract and relax by vasomotor action. Great care must be used not to overdo this procedure. After the baths, the skin must be carefully dried, particularly the skin between the toes; this region should be swabbed with alcohol, and a drying powder used to prevent excoriation of the skin.

The most effective method of increasing the circulation of the affected extremities is by

induction of fever. This has a high degree of efficacy in cases in which there are trophic lesions, ulcers, and gangrene. Relief of rest-pain can be obtained in more than 80 per cent of cases. Barker's (6) studies have shown the high efficacy of this method for healing trophic lesions. At times, relief of pain may be obtained with one injection of the vaccine, and in other cases three or four injections at intervals of 2 or 3 days may be necessary before beneficial effects are noted. Elevation of the oral temperature of from 1 to 2 degrees F. is ample. In my experience only two types of vaccine have been satisfactory, the Lederle triple typhoid vaccine, and the Lilly typhoid antigen H. With these the chill is minimized and the fever is accentuated. The intensity of the chill usually can be reduced by administration of warm drinks, with or without alcohol. Precautions in the use of fever in treatment must be emphasized. This treatment should not be used if the occlusive process is the result of arteriosclerosis, or if patients have coronary or renal disease. Hench, in his analysis of therapeutic uses of fever induced by injection of non-specific protein, has noted the occurrence of thrombosis in 2 cases of disease of the arteries. Thrombosis is a rare complication of any form of intravenous treatment.

Other methods for producing fever are used, such as intramuscular injection of sulphur in oil (40). The objection to this is the pain at the site of injection, which limits its use to the more insensitive type of patient. Injections of solution of sodium citrate (37) and injections of hypertonic salt solution (33) have been used with good results. In my opinion, their efficacy depends on the mild fever induced.

If ulcers and gangrene are present, two factors are paramount: first, relief of pain; and, second, treatment of the secondary infection that usually is present. For relief of pain, treatment by fever usually is successful. For infection, the part is soaked in warm physiological salt solution or in warm boric acid solution. The time of soaking is gradually increased until periods of a half hour to one hour are thus employed three or more times daily. Opiates may be necessary for a few days, then sharply discontinued with increasing relief. When pain is being relieved, and healing of ulcers is progressing, moist packs of thiocresol are used to stimulate healing. These measures may be combined with application of anæsthetic solutions or anæsthetic ointments. Alcohol given by mouth has distinct usefulness in relief of pain caused by ischæmic neuritis and ulceration; at times it is much more effective than morphine. Alcohol is particularly valuable in relief of the trophic pains of arteriosclerotic disease, in cases in which treatment by induced fever is contra-indicated (14); fairly high degrees of vaso-dilation can be demonstrated.

For treatment of claudication, the most effective measure, in my experience, has been administration of pancreatic tissue extract (28, 31) (Frey-Kraut hormone). Figure 4 shows the increase in tolerance to exercise following intramuscular injection of 3 to 5 cubic centimeters of this preparation. In many cases mild claudication serves a useful purpose in enforcing less use of the feet. The reasons for restriction in use of the feet should be made clear to the patient.

The treatment of superficial phlebitis is not entirely satisfactory. Resection of an inflamed vein of a foot is not advisable; for more proximal lesions this is an effective measure. Roentgen therapy may be employed for its analgesic effects and gold sodium thiosulphate may be injected.

Surgical measures. Surgical treatment of thrombo-angiitis obliterans has consisted largely in operations on the sympathetic nervous system. The perivascular neurectomy of Leriche has been shown to be without permanent vasodilating effect. At present, sympathetic ganglionectomy is the operation of choice.

Selection of cases for application of this operation are essential, and the importance of correct diagnosis must be emphasized. The age, general condition, and occupation of the patient are important factors. Patients whose extremities are exposed to abnormal trauma need the protection afforded by this operation more than those who do clerical work and whose chances of trauma are greatly lessened.

Before sympathetic ganglionectomy, the following conditions must be satisfied if sat-

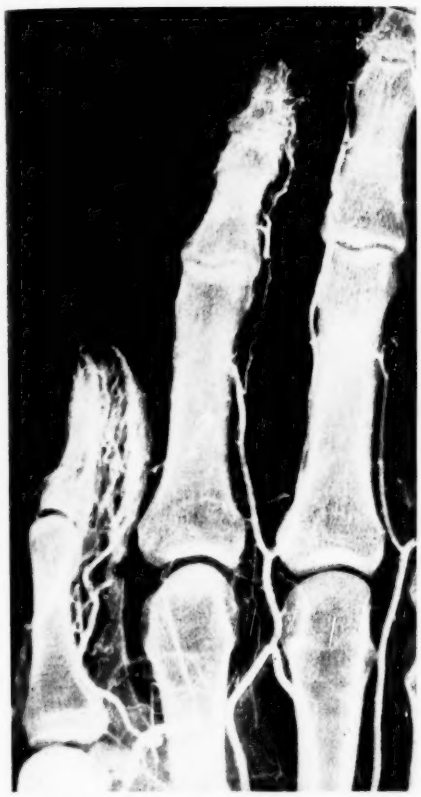

Fig. 2. Visualization of digital arteries with thorotrast, accomplished by Allen. Occlusion of an artery of the second finger is segmental in type and a collateral artery is developing.

factory results are to be expected: (1) Satisfactory grades of vasodilation in the affected extremity should be demonstrated by the preoperative studies. (2) The general condition of the patient must be carefully evaluated. It is particularly necessary if patients are between the ages of 40 and 55 years, to make certain of the condition of the coronary circulation (32). With increasing experience, an increasing percentage of patients with symptoms of coronary sclerosis are being found among those with Buerger's disease. The presence of this condition excludes the possibility of sympathetic ganglionectomy. (3) The operation should not be performed to relieve pain caused by ulcer, gangrene, or ischæmic neuritis.

Fig. 3. Gangrene and burn produced by application of too concentrated solution of germicidal preparation in a case of thrombo-angiitis obliterans.

In my opinion, the excellent remote results obtained in more than 130 cases in which operation has been performed by Adson and Craig, have been due, largely, to observance of the pre-operative precautions just mentioned. If trophic lesions are present, medical treatment should be carried out for a sufficient time to accomplish complete relief of pain, and healing should be well advanced or complete before operation is instituted. Failures following sympathetic ganglionectomy are largely the result of neglect of the precautions that have been laid down.

In addition, the following observations can be made concerning the results to be expected from sympathetic ganglionectomy. Claudication is not relieved immediately by the operation, but it gradually tends to disappear with increasing collateral circulation. In a few cases this symptom does not change. Relapses of superficial phlebitis may occur after operation, indicating that the operation has no specific effect on the activity of the disease. The operation has one highly important function; namely, protection against subsequent loss of an extremity. Proof of this rests on a recent analysis made by Adson and me in 100 cases of thrombo-angiitis obliterans in which lumbar or cervicothoracic ganglionec-

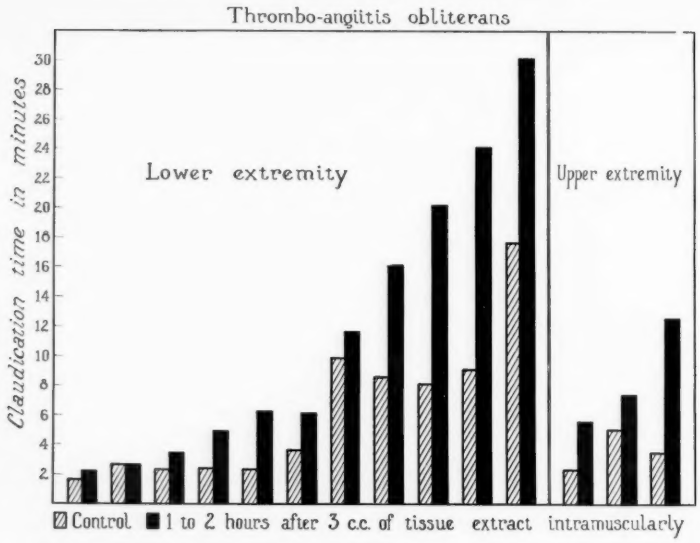

Fig. 4. Effects of tissue extract on claudication in fourteen cases of thrombo-angiitis obliterans.

tomy had been performed; the patients were traced for as long as 7 years. In 7 per cent of cases, one leg was removed within 1 month after sympathectomy, and this was necessary in 6 per cent of cases after the patients had been at home for from 2 to 7 years. In 5 per cent of cases gross gangrene of one extremity was present, and sympathectomy was carried out for protection of the other extremity. Ganglionectomy was carried out if one limb had been lost, to afford the remaining limb the maximal protection. Thus, the total incidence of amputation after sympathetic ganglionectomy was 13 per cent, but this includes 5 cases encountered early in the experience with the operation, in which ganglionectomy was performed without due attention to critical selection or adequate pre-operative treatment. In the series of patients subjected to ganglionectomy in the last 3 years, the incidence of subsequent amputation was still more greatly reduced. Barker (6) showed that with the most effectively co-operative medical treatment in 81 cases in which the patients have been followed, in at least 13 per cent of cases the patients each subsequently lost an extremity. Twenty-seven per cent of the patients seen in the years from 1928 to 1932 underwent sympathetic ganglionectomy. It is unfortunate that at the present time application of the operation must be restricted rigidly. However, at the clinic it has been found that following a prolonged course of medical treatment the patient may return in a condition in which he is entirely suitable for operation. After a period of treatment, the vasomotor component may increase sufficiently to justify operation (Fig. 4).

The value of sympathetic ganglionectomy is the high degree of protection it affords to the extremities during relapses, when the circulation of the extremities is temporarily at a low level. I have observed patients who have undergone the operation, and who subsequently have had thrombosis of the femoral artery with a resulting sudden drop in the temperature of the affected foot; however, within several days the surface temperature has been practically restored to what it was before thrombosis took place. The operation affords maximal circulation during periods when it is most necessary. The protective value of the operation cannot be over-emphasized.

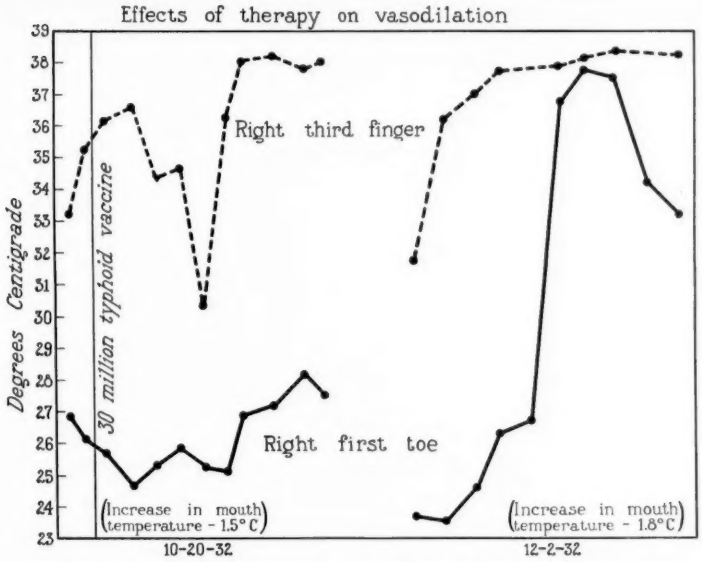

Fig. 5. There is a sharp increase in vasodilation in the toe after a period of treatment. The vasomotor indices became sufficiently high to justify sympathetic ganglionectomy.

For relief of pain in the trophic ulcers of the feet and toes in cases in which arteries are occluded, Smithwick and White have made a small incision in the lower part of the leg, below the origin of the important motor nerve branches, and have blocked the sensory nerves by injection of a small amount of alcohol, or have crushed them with a hæmostat. The sympathetic nerve fibers that are present in these nerves are also interrupted for a period of from 3 to 6 months. This has distinct usefulness in selected cases in which the pain is confined to the anatomic distribution of the sensory branches.

Statistics for 1928 to 1932 inclusive disclose an incidence of major amputations, at the clinic, of 13.8 per cent (the figures concerning amputation given in the foregoing apply only to patients who underwent sympathetic ganglionectomy) of all patients suffering with Buerger's disease, and subsequent major amputations of 7.5 per cent, making a total incidence of amputation of 21.3 per cent. That is, approximately one-fifth of the patients lost a limb. At least half of them had gross gangrene at the time of admission. Twelve subjects underwent amputation of toes and one, amputation of a finger.

Burke and Meyerding studied the cases in which legs had been amputated, to evaluate criteria for determining a site for amputation. No tests or clinical data were found to be significant except perhaps tests of patency of the femoral artery. Their data disclosed that primary amputation below the knee was eventually successful in 86 per cent of cases; in 14 per cent, higher amputation was required. Of the cases in which primary amputation above the knee was carried out, in 6.2 per cent, higher amputation was required.

The prognosis from the standpoint of preservation of limbs is undergoing revision. The pessimistic viewpoint that in most cases amputation will be required is not justified. This encouraging statement was borne out by careful follow-up studies of the complete series of 656 authentic cases encountered at the clinic. This study emphasized various facts: (1) If diagnosis can be made before the onset of gangrene, the chances of subsequent loss of a limb are sharply reduced. (2) Carefully controlled medical and protective meas-

Fig. 6. Arterial tree in amputated foot after injection with mercury by Horton. The arteries are normal except for an occluded dorsalis pedis artery. There was gangrene of the first toe, and impaired circulation of other digits.

ures effect definite lowering of the number of amputations. (3) If sympathetic ganglionectomy can be carried out, the percentage incidence of gangrene is still more reduced. (4) If major amputation is required, the amputation can be below the knee in a much higher percentage of cases than formerly was thought possible.

Another optimistic feature has been the not infrequent successful amputation of toes on which were ulcers that had proved intractable to medical treatment. Careful surgical technique was applied and postoperative measures to produce vasodilation were employed. The patients lost less time than would have been required to determine whether the primary digital ulcer eventually would have healed.

Horton's studies (19) on the collateral circulation of the amputated limb, by the injection of mercury, have demonstrated vividly that major amputation, in the past, frequently has been carried out in the presence of circulation that is excellent, with the exception of that of the gangrenous digit (Fig. 6).

I am of the opinion that, with improved technique, and with further improvement in postoperative care, amputation of the toes can be successfully carried out in a higher percentage of cases. In my experience it never has been necessary to amputate an arm because of thrombo-angiitis obliterans. Distal portions of the fingers can be amputated and successful healing can be expected.

SUMMARY

Knowledge of the symptoms, course, and treatment of thrombo-angiitis obliterans is steadily widening. The incidence of the disease is higher than previously it has been thought to be. Many cases are not diagnosed. The low incidence of 2 per cent among females is unexplained. The disease is widely distributed among the races but is somewhat more frequent among Jews than among members of other races. The etiology is unknown; infection and toxic reaction, as well as excessive use of cigarettes, are held to be important. Diagnosis of the disease before gangrene appears, more judicious handling of devascularized extremities, and education of patients will sharply lessen the need for amputation of extremities. Adequate medical treatment will control pain and cause healing of ulcers in 80 per cent of cases. Sympathetic ganglionectomy has been applied in 25 per cent of all cases for the subsequent protection against relapses. With use of these measures, the incidence of loss of limbs has been reduced to less than 10 per cent. Amputation, when necessary, can be carried out below the knee with eventual healing in more than 80 per cent of cases.

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Discussion

DR. R. W. MCNEALY, Chicago: I have enjoyed thoroughly this splendid paper by Dr. Reid. I commend his courage in choosing a subject which brings us back to the very fundamentals of our practice. May I repeat what I have said many times to my associates. The failures in surgery can be attributed more often to a lack of strict observance of elementary details than to a lack of knowledge of the intricate strategic problems of practice. I have felt for some time that there is a growing tendency for the present day teachers of surgery to overlook the importance of just such lessons as this paper has brought to us.

The older writers gave considerable attention to the technique of ligation of large arteries. In 1811, John Abernethy, the immediate successor in London to the immortal John Hunter, wrote a very precise account of the technique of large vessel ligations in his monograph, *Surgical Observations*. The following from this work is worthy of repeating: "As large arteries do not ulcerate when they are tied upon the surface of a stump after amputation, it occurred to me that it would be right to tie them, in cases of aneurism, as nearly as possible in the same manner and under the same circumstances. The large vessels on the surface of the stump continue to possess all their natural surroundings and connections, whilst they are left in a lax state, in consequence of their division." It is apparent that the surgeons of that early period grasped the importance of dividing an artery between ligatures when possible. It is likewise apparent that they appreciated the importance of leaving the vessel undisturbed in its relation to the surrounding structures. Blood vessels receive their blood supply from the vasa vasorum which come to them through the adventitia. One cannot expect the vessel to remain in a healthy state if a large part of the blood supply to its walls is destroyed. In another paragraph, the same author advises as follows: "Also, when an artery is tied with a thick ligature, the compression made by it is not so great as to produce a speedy mortification and separation of the end of a vessel, so that the ligature remains, in general, a fortnight before it is detached, and therefore, time is allowed for the consolidation of the sides of the vessel prior to its separation."

Dr. Reid's suggestion of temporary proximal occlusion of a large artery before applying the permanent ligature is, I believe, a very valuable one.

In some experimental work which we did in 1928, we used autogenous fascial bands for ligating large vessels. The ends of the fascia we anchored in neighboring muscles or fascial planes. For those who prefer absorbable material for aseptic ligatures, it is interesting to know that catgut is now available in untwisted strands one-half inch wide. These can be used as wide flat tapes or can be folded on themselves to reduce the width to one-fourth inch.

In dealing with arterial hæmatomata or false aneurisms, I believe it advisable to complete the division of the vessel at the site of injury and then suture the ends with an over and over running stitch of medium size twisted silk. This secures a firm closure of the vessel lumen and obviates the necessity of dissecting up the vessel to permit of its ligation. The danger of premature separation of the sutured stump is very remote. I agree with the essayist that no peri-arterial structures should be included in these sutures, especially is this true in contaminated or evidently infected wounds.

The essayist has bountifully supplied us with food for thought and I congratulate him on the excellence of his presentation.

DR. GEZA DE TAKATS, Chicago: The selection of these two topics, Buerger's disease and ligation of large arteries, aptly expresses the interest of surgeons throughout the country in the difficult problems so clearly defined by the two speakers.

The racial and sex predominance in Buerger's disease is difficult to explain, although there is a similar distribution of incidence in angina pectoris. Interesting light has been shed on the rôle of tobacco in vasospastic phenomena by Maddock and Coller, who convincingly demonstrated the vasoconstrictor effect of smoking in normal individuals and in those afflicted with peripheral vascular disease. This accounts for the well known beneficial effect of complete abstinence from tobacco in such patients. Alcohol, on the other hand, as Dr. Brown has emphasized, is their best friend.

For a more thorough understanding of this protean disease, more complete autopsy records are necessary. There are only 14 autopsies available, one of which is my own case, as yet unpublished. The frequent involvement of cerebral, cardiac, and renal vessels should be stressed, as the impression prevails that the vascular changes are limited to the vessels of the extremities. In the large arteries the disease imitates thrombo-endarteritis, in the medium sized vessels the thrombotic element prevails, while in the small vessels it is confusingly similar to periarteritis nodosa.

It is quite probable that with a more thorough investigation of the individual patient, particularly with the help of biopsies from small vessels of the hand or foot, many cases of so called Buerger's disease will be split off into vascular infections of known origin such as tuberculous, syphilitic and, particularly, rheumatic arteritis. In a great many respects the rheumatic infection of vessels, and Buerger's disease are strikingly similar.

Of greatest interest to the surgeon are the exact indications for sympathectomy. If we look upon Buerger's disease as a widespread, chronic, recurrent infection of the vascular system, it becomes obvious that this operation is not indicated when (1) the patient is in the stage of an acute flare up; (2) when

there is evidence of cerebral, coronary, or renal involvement of the vessels. In the few instances, where the process is quiescent, where it is limited to one or two extremities and where the healing of the infection has not produced a rigid sclerotic vessel, in other words, where vasodilation can still be obtained, sympathectomy has been of benefit. But in my small material the operation was only indicated in less than 10 per cent of the cases. In the older patient the association of arteriosclerosis will naturally vitiate the results.

The problems encountered in ligation of larger arteries readily fall into two distinct groups: First, the mechanical phase of arterial ligatures, and, second, the dynamic effect of ligatures on circulation.

The fact that parenchymatous bleeding is easily controlled by high frequency current should not lead to undue enthusiasm in replacing ligatures of large arteries. The immediate hæmostasis following the use of the high frequency current is due to a contraction and retraction of the artery. But the necrosis of the vessel wall, which as the speaker has shown, occurs in all aseptic ligatures, is so rapid and extensive that a secondary hæmorrhage is more likely to occur. The electric cautery must not be used to replace ligation of larger arteries.

I most emphatically subscribe to the use of silk instead of catgut for ligation of large arteries. The temporary proximal occlusion as a means of avoiding a rupture of the diseased artery when tied under increased tension is a most significant suggestion. The importance of partial ligatures in producing slow occlusions has lead to the extensive researches of Tschmarke from Payr's clinic, who has used fascial strips twisted into strands and has been able to show a gradual increase in occlusion instead of the usual progressive dilatation of the partially occluded segment. Such partial ligations have been successfully employed to reduce certain types of splenomegaly.

Common carotid ligations, which I have performed in eight patients for pulsating exophthalmos well illustrate the importance of preliminary temporary compression, the use of wide fascial bands to produce minimal intimal injury and concomitant jugular vein ligation. The controversy about the ligation of the concomitant vein to improve the consequences of arterial obstruction is not yet settled. Nor is much known about the incidence of peripheral embolism following arterial ligatures except after ligation of the common carotid artery, where the cerebral complications are not only due to the anæmic softening of the brain, but to peripheral emboli.

Perhaps the most intriguing problem of arterial ligations is the autonomic shift of blood flow away from the ligated stump into the collaterals, thus aiding the spontaneous control of hæmorrhage. When Bier spoke of the "blood thirst" of the tissues following arterial occlusion he plainly stated that this mechanism was independent of nerve supply. That oxygen-want, accumulation of carbon dioxide and tissue metabolites are vasodilators has been well established. Histamine, acetyl-choline and the recent pancreatic extract of Frey, which is activated in the acid medium of the tissues deprived of oxygen, have all been made responsible for the reactive hyperæmia following arterial occlusion. Whether this is a useful mechanism, or whether, as Albert suggests, a peripheral vasoconstriction, brought about by the simultaneous ligation of the concomitant vein, is of more benefit to the limb, is yet an open question.

Many other problems of peripheral circulation await solution. Arterial ligation must not be regarded merely as an act of turning off the faucet. In an effort to satisfy the oxygen-want of deprived tissue, nature has provided complicated mechanisms, the study of which behooves all of us who wish to be more than mechanical surgeons.

SYMPATHECTOMY IN CHILDREN[1]

D. E. ROBERTSON, M.D., F.A.C.S., TORONTO, CANADA

SINCE Royle first performed the operation of ramisection for the treatment of spastic paralysis there has been a wide field developed for the use of the operation or a modification of the operation. Perhaps the condition for which he first used it has been the one which gave the least gaugeable result. The conditions for which it was subsequently used for the most part gave dramatic and outstanding results.

At the Hospital for Sick Children in Toronto we have been doing operations upon the sympathetic system for a variety of conditions and up to the present time our records show that 104 patients have been submitted to one or more operations to remove or interrupt parts of the system. The operations upon these patients have been done by no single member of the surgical staff but by all the 6 members and is at the present time a routine proceeding in certain classes of cases. In no case have we had a fatality or an untoward event in connection with the operation, or at any time subsequently, attributable to the operation.

The experience gained the past 18 years has amply demonstrated that a definite effect accompanies and follows the interference with and destruction of local segments of the sympathetic system, and of the three main effects produced there seems to be one about which there is a conflict of opinion, viz.: the diminution of tone in skeletal muscles, as first enunciated by Royle. Of the other two effects, the relaxation of sphincter spasm and the relaxation of vasoconstrictor action, there do not seem to remain any negative opinions. Conflict may still wage, and with justice, about the permanency of these changes, but there can be no reasonable doubt of the fact of a change being produced irrespective of its duration.

My chief aim in this paper is to give you a résumé of our practice in the treatment of certain conditions in childhood (to 14 years) by surgery of the sympathetic system.

Spastic paralysis. Since Royle first operated upon a patient for us, a girl of 12 years who suffered from a spastic diplegia, we have done operations for this condition in 25 cases. The first case he did was a diplegic with normal mentality. She had previously had Stoeffel's operation done, partial division of the popliteal nerve, and tenotomies of her tendo achillis. These operations had left her in a state much worse than her original condition. Following the sympathectomy she did not demonstrate any change in the muscle tone or reflexes that one could gauge by a neurological examination. The patient did, however, demonstrate an improvement in balance and a marked diminution in the adductor spasm she formerly had. Added to this the concomitant beneficent vascular change made the patient and parents pleased with the result, although it was not of the type nor the extent anticipated. One must be fair when attempting to appraise the results of sympathectomy in patients who have had an upper neuron lesion. It is notoriously difficult to improve these conditions. Patients with spastic paralysis, Little's disease, etc., are extraordinarily variable in mental caliber and physical disability. It is not even agreed as to the primary cause of the condition, whether it is a developmental defect or a pathological change. There is probably no surgical condition that has for its relief so many futile or misconceived procedures as spastic paralysis. From our experience, following a sympathectomy there is doubtless a diminution of spasm, particularly of adductor spasm, and the patient is improved in gait, and what is almost as important he is ever so much more comfortable in that the extremity is warm and dry and free of pain in cold: and I think no one has any right to lead a patient to expect more than this from the operation, but this much is well worth while and to my mind constitutes the best single operation which is available for this class of case.

[1]Presented before the Clinical Congress of the American College of Surgeons, Chicago, October 9–13, 1933.

Hirschsprung's disease. The results of the operation in the relief of sphincter spasm have been widely tested in Hirschsprung's disease, if one admits the cause of Hirschsprung's disease to be explained by Hurst's achalazia theory. There is certainly in the literature up to the present time series of and single cases that attest to an improvement following an operation upon the sympathetic system in the treatment of this condition. One of Royle's observations in his first case was that a constipation in the patient had been relieved. Our experience in Hirschsprung's disease in children has been that in every instance the condition has been relieved, but not in all cases completely. We have had 9 cases. The operation in this type of case has made it possible for a child to have a normal bowel habit, but it did not impel it to have a normal habit. Supervision was necessary following the operation and for years afterward, and if this was intelligently carried out one may have what is truly a cure of the condition. I am not concerned here with a discussion of the *modus operandi* of the result produced but with a discussion of our results. Two of our patients died after they had assumed a regular habit and had apparently been cured. The first patient, elsewhere reported and again reviewed here (4), gave a most dramatic performance of the rehabilitation of bowel function. Months after the operation, when leaving hospital (she had a cardiac lesion) she was normal in abdominal contour, she was having daily or more movements. She went out to a home where she got no care or attention. She was again seen in hospital with her large bowel packed with fæces. Enemas readily produced results and she again became apparently normal. Again she went out, and a year later was admitted to the hospital in a dying condition, vomiting a yellowish fluid, having thin, yellowish movements, and an enlarged sigmoid doughy with fæces. She died, the postmortem showing an enlarged sigmoid with marked thickening of the circular muscle. The lumen was filled with a large mass of fæces, fluid, and was soft on the outside, dry at the center. Her death was typical, with the exception of the fluid movements, of the sudden illness and death occurring in surgically untreated Hirschsprung's disease. The second patient to die died almost a year after operation. His bowel function had never become really free or regular. When he was found to have an accumulation of fæces one day he had ordered for him a series of enemas. His large bowel was found to contain an ordinary amount of fæces and the enemas soon returned clear. Three hours afterward he developed convulsions and died. Permission for an autopsy was refused.

The remaining patients are well, but two of them have had to have close supervision as on one occasion each has had an accumulation of fæces while having daily movements. Therefore I believe that these children should have fortnightly enemas following operation to make sure that the large bowel is not accumulating fæces—this in spite of a daily or more frequent movement.

None of the patients we have operated upon have been submitted to operation until the parents and physicians had exhausted their resources, and following operation the outstanding points were the beginning of spontaneous bowel movements or the facility with which a movement could be produced, the diminution in the size of the abdomen, the diminution in the size of the colon, and the great improvement in the general health of the child.

Still's disease. In 2 cases operation has been done, one a very advanced and severe case. The lumbar trunks were excised; the pain and vascular condition of the lower limbs very markedly improved. The patient's comfort was greater, but that was the net result. The second case was an early one, with joint swellings and deformity in the legs. Resection of the lumbar trunks caused, or immediately preceded, a rapid and complete return to normal in this child. This result was striking and would encourage one to operate in these cases at as early a stage as they could be found.

Scleroderma. One patient only in this type of case has been treated. A child 10½ years old had thickened cyanotic skin. This was most marked on her limbs. The skin temperature was below normal. Massage had failed

to improve the condition. One year and a half ago the lumbar sympathetic trunks were excised, and the characteristic vascular changes were noted in the legs and lower part of the trunk. The cervical and the stellate ganglia were removed, and the arms and trunk, head and neck were then improved also. Examination now reveals a child 12 years of age who is in excellent general health with a remarkable increase in energy and a complete loss of her lethargy. The examination of her skin discovers no abnormality except that it is dry and warmer than usual. Subjectively, she says her hands and feet are always gratefully warm.

Anterior poliomyelitis. Sixty-eight of our patients operated upon had had infantile paralysis. They had been long past the acute stage, past also the stage of recovery and had reached the stage of deformity, and were brought to hospital for the surgical treatment of the deformity.

Patients of this type of case invariably show an atrophic limb with shortening. The skin of the limb is a plum color, mottled, and cold and moist to touch. Subjectively these children complain of the coldness of the limb and in cold weather, in spite of all the additional covering they can get on their limbs, cry of cold and pain. They suffer to such an extent in cold weather that they have to have their clothing removed and the limbs briskly rubbed before they can get comfortable from the pain imposed by the cold. We have found that when this type of patient is being submitted to a surgical procedure for the alleviation of a deformity or the stabilization of a flail condition a sympathectomy is an excellent complementary operation. By it the sweat glands to the limb are rendered inactive and the vasoconstrictors of the blood vessels are no longer in spasm. The leg has a great increase in blood supply, has changed its color from a plum to a pink, and is warm and dry to touch. Subjectively it is comfortable to the patient, and in most of our cases these children who have had one side only done say the normal side is cold and for that reason troublesome. In addition to this most comfortable and grateful change the increased blood supply to the limb must be a beneficent factor. It occurred to Harris that as a result of this increased blood supply, acceleration in rate of bone growth might be expected, a result that would be most happy in these short atrophic poliomyelitis legs. There are cases that demonstrate that there has been a definite acceleration of growth in the limb on the same side as the sympathectomy, but the gain in length has not proved to be of such degree as to be in itself a cause for the operation. In one case in which a stabilization of the foot and a sympathectomy were done, and an infection was subsequently found in the wound in the foot, the infection cleared up so quickly that it was felt that the increased blood supply had been a factor in the short duration of the infection.

It has been found impossible to have all the cases of this type return to hospital for examination. So many of them come from the hinterland and backwoods of Canada that we cannot find the means to bring them back for review. But of those that are available we can definitely show that in each case examined by the thermocouple the skin temperature is not in any case found to be below that of the normal leg on the side not operated on, and in practically every case it is 1 or 2 degrees above, and this in some patients operated on as long as 5 years ago. There may be some cases in which the limb by actual test is found to have relapsed to its original coldness, or at least to below the normal side, but if that is so it is most unusual and may of course have been due to an incomplete operation. In every case examined in this group there was no uncertainty as to the subjective result, and in practically every instance the parent said the operation was well worth while from the comfort factor alone.

The early experimental work on animals upon the sympathetic nervous system showed the characteristic vascular change, but it was found to be non-permanent. Our experience in humans has tended to the reverse. Patients operated upon 6 years ago have in our experience retained a vascular change. It may not be as pronounced as it was in the immediate time following the operation but it is still present to a degree that is of importance to the patient.

The entire question of results must be considered in the light of the completeness of the operation. I think that there can be no doubt but that the original ramisection left a very real possibility of missing some rami. I consider the present excision of the trunk a much more definite and certain procedure and one that may be done by a general surgeon as a standard procedure. In this series of cases the procedure has been a trunk resection, with the exception of the first few cases. An anomalous anatomical arrangement of the trunk might lead to missing it altogether or removing only part. This, of course, would vitiate the result, and in one case I know of this very thing happened, and a later complete operation gave the desired clinical result. In children our experience has been that the trunks are very rarely, if ever, abnormal in position or arrangement. The identification of the trunk is best made by feel, and then careful dissection of the cord-like structure will be found to be effective in giving the changes associated with this type of operation.

OPERATION

The operation upon the lumbar sympathetics has in this series of cases been done invariably by the lumbar approach as described by Royle. In those cases in which a trunk on either side was to be operated upon one side was done and the child turned over and the other side operated upon. In the earlier cases the gray rami only were divided, as described by Royle, but in the later cases the excision was done of the whole trunk, including the second lumbar enlargement down to the fifth lumbar enlargement. This necessarily broke all the lateral and mesial connections. The technique of the operation is not difficult if one pays attention to the essential details. The skin incision extends from the twelfth rib downward to the posterior iliac spine, then around to near the anterior superior spine. To my mind the important step is next to identify the trigorum lumbali (Petit's triangle). When this fibrous membrane is identified it is perforated and with the fingers one can then feel the edge of the erector spinæ muscles. The aponeurosis at its lateral margin is divided up to the level of the twelfth rib. The finger is then passed around under the internal oblique muscles parallel to the crest of the ilium. The attachment of these muscles is then divided to a point close to the anterosuperior spine of the ilium. What bleeding is encountered in this division is controlled. The index fingers of both hands are introduced into the wound and with a sweeping movement is pushed forward the parietal peritoneum, the line of cleavage is readily found separating this peritoneum from the fascia covering the psoas muscle. With a sweeping movement this cleavage is continued until one is well past the midline, and one may feel with the ball of the finger the rounded anterior surface of the bodies of the lumbar vertebræ. This stage of the operation is entirely bloodless unless one has had the misfortune to be in the wrong line of cleavage and to be under the lumbar and psoas fascia. Having identified the right plane and freed the peritoneum from the overlying bodies of the lumbar vertebræ the fingers are carried sufficiently down until the promontory of the sacrum is felt and up as high as the level of the second lumbar vertebra. At this stage one may feel without difficulty the distinct hard cord-like structure of the sympathetic trunk while it is still covered with fascia and lying upon the anterior surface of the bodies of the vertebræ. It is identified by touch, which is by far the easiest and quickest and the most positive method. Having identified it, retractors are then used and the region visualized. An instrument the shape of a long thin paper knife, the terminal half inch of which is bent at an angle of about twenty degrees and which is well pointed, serves to divide the fascia over the cord. This having been done, through this opening the instrument may be hooked under the trunk, and it will be found that this facilitates the dividing of the remaining fascia and the freeing of the trunk. If the operation is done carefully, there need be practically no bleeding after the stage of dividing the muscles has been passed. We have never had in any case hæmorrhage from the main abdominal vessels, but from some lumbar tributaries to the inferior vena cava we have had bleeding of a minor character which was readily controlled.

In one case we had a very extensive infection of the wound, but this child drained freely, had no very marked constitutional symptoms, and after a period of 3 or 4 weeks the wound closed up, and now 2 years after the incident she has had no further trouble. In no case has there been a hernia following operation. In all patients who have been operated upon the muscles have been sewed together with catgut, and the skin generally with No. 0 plain catgut.

The type of operation that has been done in the cervical region has been, with the exception of the first 2 cases that devised by Henry. In children this operation has proved a reasonable procedure and is fairly easy of accomplishment. The technique is fairly simple.

The child is laid on its face and the spine of the seventh cervical, vertebra prominens, is identified. A skin incision is made from the level of the sixth cervical to the level of the fourth dorsal vertebra. Subcutaneous fascia being divided, the spinal muscles overlying the ribs of the transverse processes are split and an attempt is made to identify the tip of the second transverse process. This is the most difficult point in the operation. It was found that the tip of the transverse process of the second dorsal vertebra is on the level of the tip of the spine of the first dorsal. This having been identified, a scalpel is used to divide the periosteum of the transverse process and a periosteal elevator then frees the transverse process of periosteum. A sharp, narrow osteotome then divides the transverse process from its body. With a pair of bone forceps, the transverse process is torn from its bed, and one may then without difficulty identify the second rib underneath. This is freed in a simple fashion by elevating the periosteum, and with a pair of sharp bone forceps the rib is divided at its angle. A sharp, small curved gouge is then passed along the dorsal aspect of the rib to the articulation between the rib and the body of the vertebra. The ligaments of this articulation may be easily divided and the complete head and neck of the rib removed without difficulty. In the quadrilateral space then left between the first and third ribs one can push down with the finger, pushing forward the periosteum and pleura until a space an inch or so deep is created. On removal of the finger one will then find the trunk lying across the space with a swelling on it which is the second dorsal enlargement which has been directly opposite the head of the second rib which has been removed. Having divided the cord below the second enlargement, one can then put a forceps on the enlargement, divide its attachments, and pull then in a downward direction, freeing as they come into view the branches running from the first thoracic and inferior cervical (the stellate ganglia). When this has been completely freed the cord above is divided. This operation should free all of the known fibers which run to the brachial plexus.

This operation in children has been done on both sides at one sitting, and we have never had to limit ourselves to one side on account of the inability of the patient to stand the procedure. It is an amazing fact that these operations on the sympathetic cord have in our experience been entirely free of shock.

The anæsthetics that have been used have been various types of general anæsthetics, but for the operation on the lumbar sympathetic the use of spinal anæsthesia rendered the operation very much easier. For the operation in the cervical region an intertracheal anæsthesia is much the best.

This operation produces a Horner's syndrome. Where it is bilateral it probably enhances the appearance of the face, but where it is unilateral the reverse is true.

We have in no instance approached the lumbar sympathetics transperitoneally, so that we are not in a position to compare our results with operations using that approach. Our youngest patient was 11 months and the next youngest 15 months of age. The subsequent history in these, as in all the others, has not revealed any disability arising from or produced by the operation. One may say at this date that as long as 8 years after this type of operation there has been no untoward effect. It is certainly true in our series of cases. In our cases even where there has been an excision of both stellate ganglia as

well as a trunk resection of the lumbar cords, there have been no harmful effects. Therefore, it is believed that this procedure is one that may be recommended and carried out with confidence, in those conditions in which it is indicated, with almost positive assurance that the patient will be benefited. If no benefit should follow the operation at all events the condition of the patient will not be rendered worse.

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OPERATIVE LENGTHENING OF THE FEMUR[1]

PROFESSOR VITTORIO PUTTI, BOLOGNA, ITALY

THE subject of bone lengthening has held my personal attention for many years, particularly during the period of the Great War and the reconstruction period immediately following. During that time my efforts were largely confined to the severe injuries of the lower extremities characterized by extreme shortening of the femur due to mal-union of bone and extensive trauma to the soft tissues. To simplify the operation for bone lengthening, I have designed a special apparatus for forcible skeletal traction and have obtained results which are considered eminently satisfactory.

With the introduction of piano wire for skeletal traction in the treatment of fractures of the long bones, I soon became convinced that it was applicable not only in the treatment of the acute cases but as well in effecting operative bone lengthening in the presence of chronic deformities of the lower extremities associated with shortening of the femur due to other causes. In addition to the definite advantages of piano wire traction now familiar to all, I have been particularly impressed with the fact that it makes possible treatment of a number of cases including many orthopedic deformities peculiar to childhood, for which heretofore no attempt was made with the osteotome.

The simplicity of the wire traction technique further makes possible its application in operative bone lengthening during the period of childhood when the reparative power of the long bones is most vigorous, thereby minimizing the dangers of non-union. Let me mention here in passing that the term "skeletal traction," in so far as it applies to operative bone lengthening, presupposes the use of fixed countertraction, which does not of necessity apply to the treatment of acute fractures.

[At this point Professor Putti presented a motion picture film which showed clearly the steps of the operation. As we are unable to reproduce the film, we have asked a former pupil of his, Dr. Carlo S. Scuderi, to outline the steps of Professor Putti's operation. A short description of the technique follows: The two illustrations are taken from *La Chirurgia degli Organi di Movimento*, 1933, xviii, 105.]

TECHNIQUE

By Carlo S. Scuderi, M.D., Chicago

The patient is surgically prepared the day before the operation. A Putti operating table is used upon which the patient can be maneuvered into the desired position. This highly specialized table has most of the virtues of the Hawley and Albee tables.

Under ether anæsthesia and iodine preparation of the skin, a Kirchner wire is inserted through the soft parts and the underlying greater trochanter of the femur, in the anteroposterior axis. This step is very easily and rapidly done by means of a motor driven drill or wire inserter. Another wire is inserted through the supracondylar region of the femur running from the outside in. This wire is inserted in the horizontal plane.

A long incision is made over the lateral aspect of the thigh in the middle one-third, and is carried through the subcutaneous tissue, fascia lata, and vastus externus down to the shaft of the femur.

In the earlier cases, the author used the step type osteotomy. This, however, was more difficult and offered no real technical advantage over the oblique osteotomy so that now the latter method is used almost exclusively in lengthening of the femur.

After closure of the wound and the application of the dressings, the patient is transferred to the bed and placed in traction on a Braun frame. The upper wire is firmly fixed to the upper part of the bed by heavy braided wire. Increasing traction is applied to the lower Kirchner wire, beginning with 7 to 8 kilograms (15 to 17 pounds) and from then on, 1 to 2 kilograms (2 to 4 pounds) are added daily until the desired lengthening—usually from 2.5 inches up to 4 inches—has been attained. Greater lengthenings are dangerous. The traction period usually requires 18 to 21 days.

Careful radiographic check up films are made about every third day during the entire period of extension. Great care is taken to insure against the development of any neurological symptoms due to stretching of the sciatic nerve or to excessive narrowing of the caliber of the popliteal vessels.

When the desired length has been attained, a sacral rest is inserted under the patient while still in traction, and a spica cast is applied from the costal margin down to the tip of the toes on the side operated upon. Very little padding is applied, and great care is used in fixing the wires snugly in the cast.

[1]Presented with motion picture film depicting technique, before the Clinical Congress of American College of Surgeons, Chicago, October 9–13, 1933.

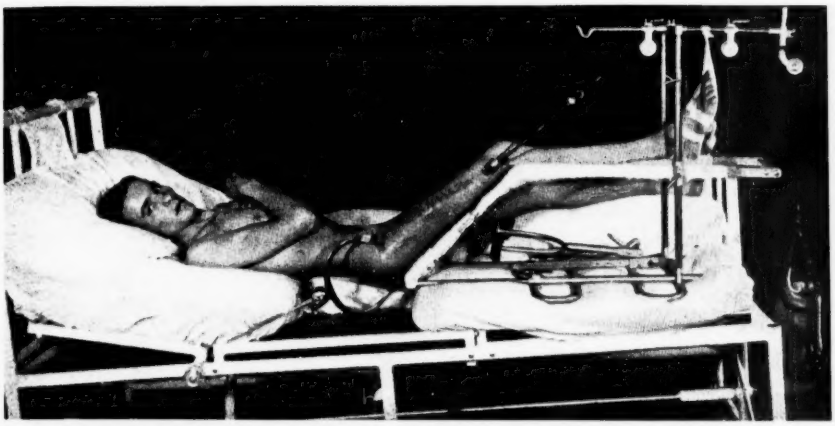

Fig. 1. Note operative scar, position of semiflexion of hip and knee obtained by double incline plane (Braun frame), traction on distal portion of shaft and countertraction through greater trochanter.

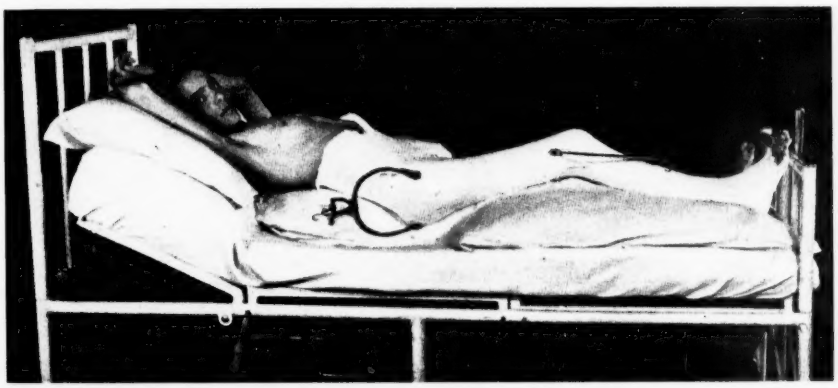

Fig. 2. The apparatus maintains exact position of bones during period of elongation and remains *in situ* until complete consolidation of osteotomy occurs.

The traction remains in place until the cast hardens, then it is disengaged and patient is moved from the Braun frame onto the bed. Pillows are now used to prop up the limb which is enclosed in the cast.

The wires are usually allowed to remain *in situ* for 3 to 5 more weeks. If roentgenogram reveals adequate callus formation, and the patient is comfortable, the wires are removed. After a few more months another cast is applied with less flexion of the joints and the patient is gotten up. Should the roentgenogram reveal inadequate callus the wires are left *in situ* for a longer period unless signs of infection around the wire are present. The patient requires immobilization from 8 to 10 months in all.

[Professor Putti continues:]

I have always found the operation very useful in correcting short extremities in the adult who has suffered from an irreducible congenital dislocation of the hip, particularly if the patient previously has had a Lorenz bifurcation operation but still has an unavoidable degree of shortening not conducive to the best functional results. I have used piano wire traction in 11 cases for bone lengthening of the femur. One patient had a shortening of the femur due to extensive destruction of the head and neck following the healing of a

tuberculous hip. Four patients were treated for old congenital dislocations of the hip, and 3 of these had been operated on for joint stability after the method of Lorenz. I have in my records many other cases in which operative bone lengthening of the femur was done for the correction of shortening deformities due to healed fractures but I have purposely omitted them as I wish to confine my remarks to a few important points in technique covered in the cases chosen.

My experience with bone lengthening since the Great War has emphasized in my own mind the fact that one must give much study to the muscular and ligamentous structures attached to the femur, as the handling of these structures in my opinion presents the greatest difficulty encountered in obtaining a successful result. In this regard I keep in mind two distinct types of cases: first, those in which the primary object is muscle extension from the retracted state, and second, those cases of a more chronic nature which require hyperextension—in reality amounting to a true muscle lengthening operation by slow skeletal traction. I find the latter group infinitely more difficult, even though osteotomy may be performed through perfectly normal bone tissue.

In the 11 cases I have treated by this method no complications whatever arose other than a single case of temporary "toe-drop" caused by overstretching of the external popliteal nerve presumably due to faulty position of the knee. The paralysis promptly cleared up with rest and postural treatment.

The most important feature of the wire traction technique is the proper position of the extremity during the traction and countertraction period. With the patient in the supine position I make allowance for semiflexion of the hip and knee which furnishes the greatest degree of relaxation to the soft tissue.

The time required to obtain the desired lengthening is approximately 20 days, that is, in general, the same as the period required for fibrous union in the operative repair of acute fractures. Countertraction is fixed but the force of weighted traction varies—on the average about 30 to 40 pounds. During the traction period the leg is supported on a double incline plane splint until the desired lengthening is obtained.

The period of immobilization in the corrected position requires 4 months in a plaster cast and an additional period of limited support for several months during which physical therapy is administered.

When treating adults I believe that there is a definite limit beyond which the fragments should not be extended. In general I find it advisable to maintain bony contact of the ends of the two fragments of the femur to avoid the possibility of delayed or non-union at the line of osteotomy. When treating children, however, I am inclined to allow greater extension of the fragments with the same assurance of successful bone repair.

Editors' Note. We wish to thank Dr. Philip Lewin for his assistance in preparing this article for publication.

Discussion

DR. WM. R. CUBBINS, Chicago: When one listens to a master oration, presented as this has been by a master surgeon, he is too often blinded to the possibility that there may be other views in relation to the subject under discussion.

It would be well for us to state here that our fellow townsman, Dr. Paul B. Magnuson, did the first experimental work in lengthening bones on animals while in the University of Pennsylvania; a report of this work was published in the Bulletin of the University in 1908. His second article was published in SURGERY, GYNECOLOGY AND OBSTETRICS, in 1913, and in this paper he dealt with the lengthening of femurs shortened as a result of the mistreatment of fractures.

Work in this field was somewhat quiet until Dr. Putti read his paper here in 1921, published in the *Journal of the American Medical Association*, and in which he described his osteotome, an instrument which he devised for the lengthening of femurs. This stimulated additional efforts and the next contribution was made by Dr. Leroy C. Abbott, of Saint Louis, in the *Journal of Bone and Joint Surgery*, June, 1929, who seemed to think that it was preferable to lengthen the bones of the leg instead of the femur. His first suggestion considered the use of two pins passed through the bone proximal and distal to the area to be lengthened. But some difficulty arose in keeping these bone fragments in contact. Dr. Abbott's next contribution was two pins above and two pins below the point to be lengthened, in order to prevent this division of fragments. This article was published in the *Southern Medical Journal*,

October, 1928. Dr. W. B. Carrell, of Houston, Texas, made an addition to this technique, a report of which was published in the *Southern Medical Journal*, in 1925, in that he used a third pin to brace the top fragment of the leg bone into position and to avoid distortion and non-union.

There is another article written by Gavin Hamilton, of Houston, Texas, in the state medical journal, October, 1922, which presents a very ingenious method of lengthening the femur at one sitting, but no case results are shown to prove its efficiency.

With this résumé of methods of lengthening the limb we approach the other angle, that is, of shortening the well limb in order to compensate for the disparity in length of the limbs. The first and most commonly used methods have been best exploited by Dr. Robert O. Ritter, of Dr. Edwin N. Ryerson's Clinic, where a segment of the normal femur has been removed and the end re-approximated over an intramedullary bone peg. Royle, of Sydney, N. S. W., bored the shafts in such a manner that he was able to remove the segment and leave a dentate surface which permitted an accurate fit and gave a broader surface for bone growth with little likelihood of slippage.

The last contribution was made by Dr. Dallas B. Phemister, of the University of Chicago, and was presented before the Chicago Surgical Society, in November, 1932. Dr. Phemister suggests a very careful analysis of the case and an interference with one of the major epiphyseal growth lines, so that the growth of the injured limb might compensate and catch up with the growth of the well limb.

This divides the authors into three groups, those who advocate the shortening of the well limb,—and one must be a little chary to injure a well limb when the other is more or less out of commission—those who advocate the lengthening of the injured femur, and those who advocate the lengthening of the leg. The question is still debatable as to which of these procedures is the safest and most likely to give a good result.

In relation to the method just shown by Dr. Putti, it is well to state that with a single wire at each end of the bone to be lengthened, in many cases it will be found extremely difficult, in spite of cross pulls of any type, to hold the severed ends of the femur in such position that they can unite. A second factor to be considered is that black beast of all bone repair —whether bone will or will not be proliferated from the cut edges even should these cut edges be in apposition; the third question is whether the severed and attenuated fragments will develop sufficient bone to make a strong limb, if they should unite; and the fourth question is the possibility of some accident causing a relaxation of the stretched limb in such a manner as to permit a malposition that might result in an interposition of some tissue that would prevent its union.

The author deserves to be congratulated upon the magnificent presentation of this subject, the beauty of the illustrations, the skill with which the operation has been performed, and the excellent results that he has shown.

DR. BEVERIDGE H. MOORE, Chicago: Our series of bone lengthenings is small—14 cases—all tibial, extending over the past 5 years. All were done at the Shriner's Hospital. The lengthening obtained has been from 1½ to 3 inches. We believe that the operation is entirely feasible but it is distinctly major surgery, and takes good team work at the operation and very meticulous control of the after care. We have had one infection in our series but it did not interfere with the union, though of course a sinus persisted for a long time, as is usual with infected bones.

We had one case which showed some nerve disturbance manifested by a partial anæsthesia of the skin over the outer side of the foot and lower leg. This was in a case which we lengthened 3 inches, and as the disturbance did not appear until about the end of the third week when the maximum lengthening was being approached, we ascribed it to stretching of the nerves. The anæsthesia cleared up in about 6 months.

Our experience in the 14 cases we have had has led us to become more rigid in the selection of cases for the operation than at first. We now do not advise a lengthening operation unless the quadriceps and the hip abductor muscles are strong. We emphasize particularly the condition of the hip abductors because when the leg is lengthened and the pelvis leveled up, the leverage of the hip abductors is changed to a major degree. They work at a mechanical disadvantage when the pelvis is level, so that unless they are strong the gait may be worse after lengthening than before. We had one hip gradually dislocate after a lengthening operation on the tibia, we believe because of weakness of the hip abductors. We have had no non-unions. It takes approximately a year for the bone to be restored to normal—that is the medullary cavity to reform completely, the cortex to be reformed and the lines of strain as shown by the cancellous bone to attain their final form. We had one boy who broke his leg playing football about 2 years after the operation. The fracture did not occur in the lengthened portion but above it, close to the knee.

One question that has interested us is whether the bone when lengthened will continue to grow or not. One done 5 years ago—our first—has kept pace with the other although the boy has grown rapidly in the meantime. Others are apparently doing the same.

THE COMMON SYNDROME OF RUPTURE, DISLOCATION AND ELONGATION OF THE LONG HEAD OF THE BICEPS BRACHII

An Analysis of One Hundred Cases[1]

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A CLEAR understanding and a thorough appreciation of the signs and symptoms of the common bicipital syndrome will explain many hitherto unrecognized lesions of the shoulder which have been and still are diagnosed and treated as sprains, neuritis, subdeltoid bursitis, rupture of the supraspinatus muscle, and most often as arthritis, or, in lieu of a better diagnosis, as "painful shoulder" or "senile shoulder." Undoubtedly a great many patients, suffering from these supposed vague conditions, have the classical signs and symptoms of this syndrome and, if an early diagnosis were made and surgical treatment rendered promptly, many of them would be relieved greatly, if not completely cured.

By this study and analysis of 100 cases, I hope that additional light will be thrown on this very definite clinical entity which will lead to better diagnoses and more effectual treatment.

By the *common bicipital syndrome* I refer directly to the wear and tear, the complete destruction and rupture, and the dislocation and elongation of the tendon of the long head of the biceps, although lesions in other parts of this remarkable muscle will be considered. In this paper I shall discuss only the wear and tear and the complete and partial ruptures of this tendon and muscle. In a subsequent paper I shall discuss the dislocations and the elongations.

The subject of rupture of muscles and tendons first aroused my interest about 10 years ago (71). By 1931 I had operated on 10 patients and had examined and collected a total of 30 cases (72). Since then I have examined, operated on, collected, and analyzed 70 more, making in all, 100 cases of lesions of the biceps alone.[2]

LITERATURE[3]

After reviewing the literature to date I find that this subject has received only casual mention in textbooks of surgery. In fact I can find no mention of partial ruptures of the tendon, simulating arthritis of the shoulder, other than in the article I wrote in 1926 (72).

The records of the University of California Hospital reveal 3 cases of rupture of the biceps; all 3 patients were operated upon. Dr. Emile Holman, of San Francisco, informed me that the records of the Stanford University Hospital reveal 2, and that one patient had been treated surgically. Dr. Melvin S. Henderson, of Rochester, has written me that the records of the Mayo Clinic since 1918 reveal 15; 6 patients were treated by surgery. Dr. Wallace S. Duncan, of the Cleveland Clinic, has reported 4 cases to me, 2 patients having been operated upon.

ANATOMY

The location of the tendon of the long head of the biceps is peculiar in that while the tendon is within the capsule it is not within the synovial cavity, although it is enveloped by the synovial membrane (42). (Figs. 1, 2.)

Action. When the shoulder is fixed, the biceps muscle acts at the same time on the forearm and arm and has a triple function: (1) it flexes the forearm on the arm; (2) it brings the forearm in supination if the radius is in pronation; and (3) it elevates the arm and brings it medially. When the forearm is fixed, as in the act of climbing, the biceps acts on the shoulder, elevating it, and on the arm, flexing it on the forearm (188).

Innervation. The biceps receives its nerve supply from a branch of the musculocutaneous

[2]These studies of the biceps naturally led me into an investigation of ruptures in the lower extremity and, consistent with the symptoms observed in the upper extremity, I found that such lesions often gave articular symptoms, particularly in the knee, which frequently led to an erroneous diagnosis and ineffectual or delayed treatment (74).

[3]Lack of space precludes my mentioning here all of the literature I have collected. However, a complete bibliography will be found at the end of this article.

[1]Presented before the Clinical Congress of the American College of Surgeons, Chicago, October 9–13, 1933.

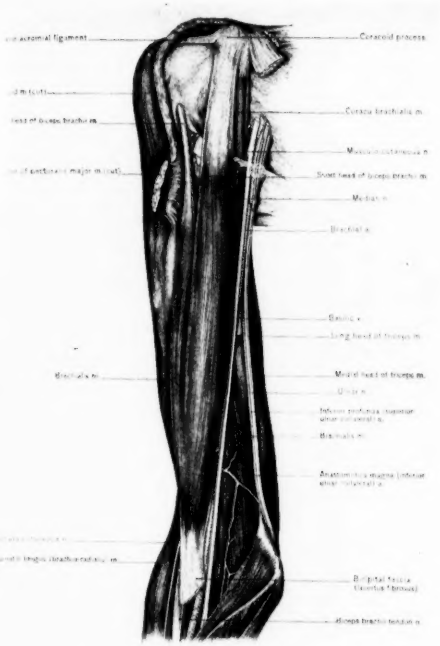

Coracoid process
Coraco brachialis m.
Short head of biceps brachii m.
Long head of biceps m.
Medial head of biceps m.
Bicipital fascia (Lacertus fibrosus)

Fig. 1. Biceps brachii muscle. (From Deaver's *Surgical Anatomy.*)

nerve, called the bicipital nerve, which reaches the deep surface of the muscle and divides itself in two sets of branches, some for the long head, others for the short head. Only occasionally the latter also receives, at its proximal extremity, a few small branches from the superior branch of the coraco-brachialis (188).

Arteries. It receives branches from the anterior circumflex artery and from the brachial artery.

Varieties. More than a half century ago Meckel pointed out that there was no muscle in the human body more subject to variations or presenting more different anomalies than the muscle of the biceps. These anomalies are complete separation of bellies, absence of the short head, absence of the long head, and absence of the muscle.

Meyer (129) wrote that as no case of congenital absence of the tendon of the long head in an adult had been found by him or his associates in more than 1,000 dissections, he concluded that the condition is rare, although absence of the long head is common.

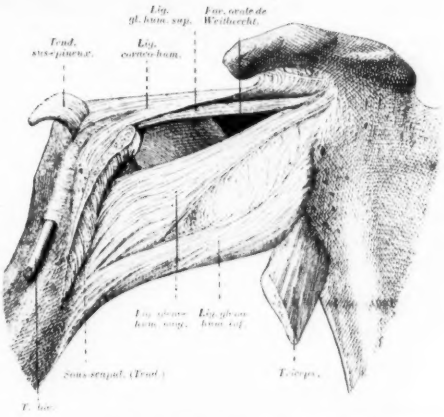


Fig. 2. Anterior view of shoulder joint revealing relationship of tendon of long head of the biceps to articular capsule. (From Poirer's and Charpy's *Human Anatomy.*)

PARTIAL TEARS AND COMPLETE RUPTURES

A. Etiology. Partial ruptures, or tears, and complete ruptures of the tendon or muscle have many causes, chief of which are: (1) Pathological and physiopathological: (a) degenerative changes, such as, senility, arthritis, myositis, and arteriosclerosis; (b) acute infectious diseases; (c) chronic infectious diseases; (d) neoplasms. (2) Physiological predisposition. (3) Occupation. (4) Fatigue. (5) Trauma.

I shall discuss these causes in the foregoing order.

1. Among the most important *pathological and physiopathological causes* are:

a. In old people *degenerative changes* cause the muscles to lose much of their elasticity and resiliency, so that frequently they, in the course of their usual work, sustain a spontaneous laceration of some muscular fibers. The tendon of the biceps, which for years has been sliding on an articular surface or groove roughened by an arthritic process, also undergoes a slow but continual attrition, which is not painful, until it finally tears. Such tears cause very little discomfort and the sole complaint is a vague soreness in the top of the shoulder and the upper part of the arm. Ex-

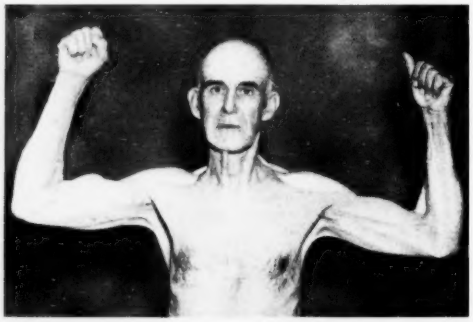


Fig. 3. Rupture of long head of the biceps due to degenerative changes of senility. Note characteristic bulging of biceps in lower third of arm, with widening of space between deltoid and biceps.

Fig. 4. Patient with rupture of tendon of the long head of the biceps which is due to a severe infection of the arm.

amination is usually negative. Liniger (119) reported 81 cases, the tears being bilateral in 16. These types often referred to as medical or tardive, are grouped by certain French authors under the heading of "senile shoulder." Clinical and roentgenological examinations are usually negative except for the customary degenerative signs of senility; consequently, these unfortunate old people receive very little sympathy (Fig. 3).

Arthritis. Intra-articular changes resulting from chronic arthritis occurring frequently in laborers, often will cause a break in the continuity of the tendon when the worker makes a rather strenuous effort. He usually suffers severe pain and immediate disuse of his arm.

There can be no further question that disease plays an important rôle in many cases. Ledderhose (110) brought out clearly by his findings at necropsy that arthritis deformans is a very definite predisposing factor in producing these ruptures. He came to the conclusion that ruptures of the long head were spontaneous and never actually caused by strain. However, Rosenburg considered strain an important factor, even though he concurred in the opinion of Ledderhose as to the arthritic factor.

Borchers explained the spontaneous ruptures within the groove on the basis of osteophytic excrescences there, which wear away the tendon.

Ewald's opinion is that a rupture of the tendon is always the result of pre-existing disease affecting the tendon in the passage through the capsule.

Muller did not entirely agree with Ledderhose or Ewald, having said that, while their conclusions may be useful in explaining the greater frequency of the rupture of the long head in relation to the other heads and its site of election, they do not explain the rupture which occurs at other sites of the same tendon (88, 80), and least of all do they explain the rupture which occurs in the inferior tendon. Supporting this view, Dreyzehner (54) studied ruptured tendons microscopically and found many of them to be normal tissue.

It remained for Meyer (129), the eminent anatomist at Stanford University, to call the surgeons' attention to a frequent but often overlooked and neglected clinical entity. He observed that "The whole picture suggested that the condition resulted from a low grade, long-standing process. . . . Next to the destruction of the tendon of the long head of the biceps with secondary attachment of the tendon stump distal to the lesser tuberosities, nothing strikes one's attention so forcibly as its total destruction by friction. That friction is very largely, if not wholly, responsible is indicated by the fraying and fringing of the other soft parts and also by fraying and shredding of the tendon itself." In reviewing some of Meyer's material with him (132) I was greatly surprised to see many specimens of the shoulder joint completely free of the slightest evidence of arthritis, revealing con-

Fig. 5. A dissection graphically revealing extensive destruction of the bursa, capsule, tendon, and cartilage. This shows conclusively that these capsular defects are extra-articular rather than intra-articular. (Kindness of Dr. A. W. Meyer, professor of anatomy, Stanford University.)

siderable destruction within the joint of the tendon of the long head of the biceps. He had over 20 specimens of absence of the articular portion of this tendon, resulting from extracapsular destruction.

From my clinical observation, while I am certain that arthritis would explain the rupture in a number of patients in my series, I am just as certain that it could be eliminated as the causative factor in others. In several of my patients the rupture was purely traumatic. Operation, with fixation or repair of the tendon in these cases, has given each patient a perfect arm. This result could not have been obtained if arthritis had been present in such a degree as to have caused the rupture. The operation in such a case, while restoring the function of the tendon, would not affect the arthritic process causing the symptoms.

Myositis is believed by some, particularly Alexander (3), to explain some ruptures which have been reported. As is well known, the rupture frequently occurs at the transitional point between tendon and muscle, and, as the tendon is stronger than the muscle, it is logical to assume that the separation occurred in the

Fig. 6. Intracapsular partial rupture of tendon of the long head of the right biceps. The ruptured tendon could be palpated curled beneath the muscle, as shown in Figure 7 A. Note deepening of furrow between deltoid and biceps.

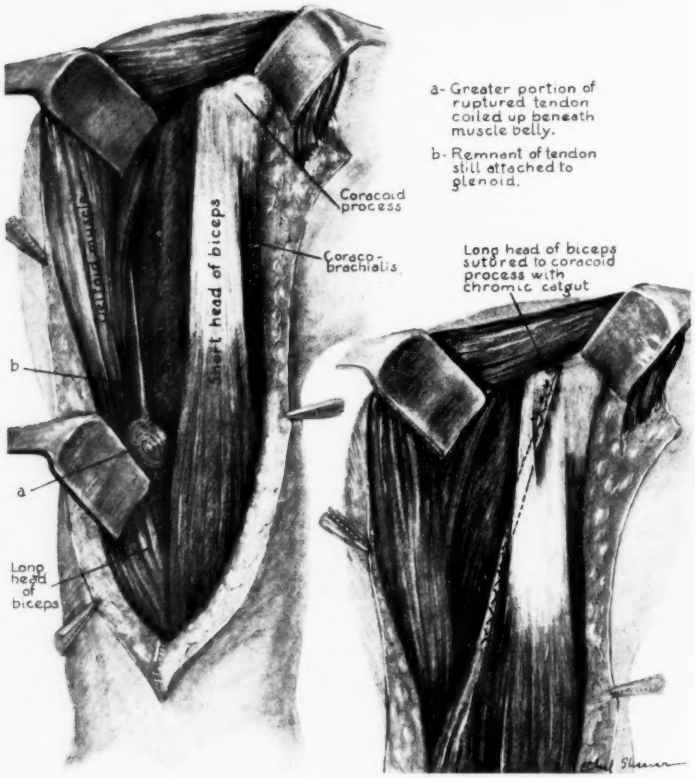
muscular side rather than the tendinous side and that the underlying cause was a myositis. Consistent with this explanation, it is further advanced that these lesions occur most often in men over 40 years of age, at the period when degenerative changes in the tissues are most likely to make their appearance.

Arteriosclerosis. Unquestionably arterial changes play a definite part by interfering with the nutrition of the tendon or muscle. This should be sufficient admonition for those on the shady side of 50 not to engage in strenuous athletics.

b. *Acute infections.* I examined one patient (Fig. 4) in whom a spontaneous rupture of the long head of the biceps followed a severe suppuration of the arm. Such lesions are rare and should be recognized easily.

c. *Chronic infections.* Syphilis and tuberculosis are only rarely the causes of rupture. I have never seen any case which I thought was directly attributable to these conditions. However, a case was reported of a patient rupturing both biceps in a convulsive seizure. This was explained on a luetic basis. One case caused by tuberculosis was reported in 1891 (52).

d. *Neoplasms.* There is no question that a neoplasm in the tendon or muscle easily would be a factor in leading to its rupture. While no case has been reported in the literature as occurring in the biceps it has been found in the patellar ligament and in the Achilles tendon.


a- Greater portion of ruptured tendon coiled up beneath muscle belly.
b- Remnant of tendon still attached to glenoid.
Coracoid process
Coraco-brachialis
Short head of biceps
Long head of biceps sutured to coracoid process with chromic catgut
b
a
Long head of biceps

A B

Fig. 7. A, Condition found at operation which reveals an old intracapsular partial rupture of the tendon of the long head of the biceps. The ruptured tendon was found curled up like a watch spring under the upper end of the muscle. A small remnant of the tendon is seen which has prevented belly of muscle from dropping. B, Suture of long head to coracoid process and to upper fibers of short head.

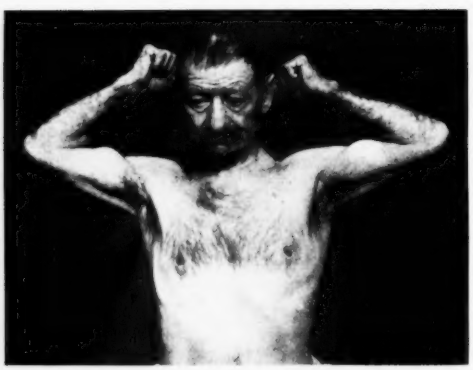


Fig. 8. Postoperative result showing complete recovery.

2. *Anatomical predisposition.* Ruptured tendons, examined microscopically, have been found normal and also diseased.

Bianchieri has brought out that rupture of the tendon of the biceps occurs most often in persons past middle life, which should lead us to admit a physiological predisposition, even though we may deny a pathological predisposition. (Dr. Meyer and I prefer the term *anatomical predisposition* to that of *physiological predisposition.*) This point of view is sustained by the researches of Rau, who on examining numerous human tendons, found that, after the age of 30 years, the circulation of blood in a tendon becomes less rich and is

Fig. 9. a, Condition found at operation which shows an old rupture of the upper end of the long head of the biceps which has jack-knifed and grown together. A small remnant of the tendon is seen still in place. b, Suture of long head to coracoid process and to upper fibers of short head.

reduced gradually to a few short vessels which enter it and the peritendinous membrane. Thus, its tensile strength is, as a result, considerably weakened and gives way even under a slight strain.

3. *Occupation.* Occupational causes (extra-articular) must be considered as playing an important rôle (Fig. 5). When these shoulders are opened one observes the changes within are not in any sense inflammatory in nature. There is no collection of fluid or pus, nor is there the slightest evidence of arthritis. Further, as shown microscopically by Meyer, there is no inflammatory reaction. What one observes is a definite local area which has yielded to the stress and strain of years of toil and has become worn, threaded, and frazzled. The tendon of the long head of the biceps finally frays out like a rope and the various strands take on new and lower attachments.

Meyer (129), reviewing his specimens, was impressed further by finding early defects in the capsule near its attachment to the greater tuberosity. He reasoned that these capsular defects resulted "from repeated and long continued use of the arm in a position of marked abduction and external rotation." These

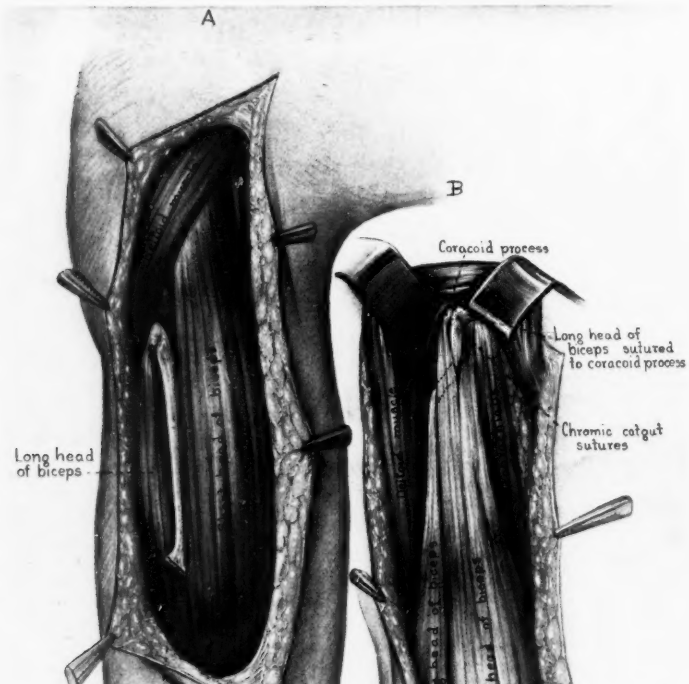


Fig. 10. A, Condition found in operation which shows the long head of the biceps torn off from the cartilaginous lip of the glenoid completely turned over in a jack-knife fashion; B, long head of biceps sutured to coracoid process and fortified to upper fibers of the short head.

observations naturally led him "to consider the possibility of an occupational cause." He concluded that the incidence of spontaneous destruction and dislocation of this tendon must be exceedingly common in laborers working in lumber and construction camps and in mines. A sudden trauma in such cases, therefore, is only the immediate cause.

4. *Excessive fatigue* may render the muscular fibers less likely to resist a sudden and forceful pull or jerk. Roth, in his researches, noticed experimentally a waxy degeneration of the muscular fibers, when they were very much fatigued, as well as a greater fragility caused by a decreased cohesion, elasticity, and contractility. If the fatigue is superimposed

up[on] old pathological or senile changes, the exh[aus]tion and consecutive tear of the muscular f[i]bers are more easily produced. Weissman cit[es] a case of Loos, a man of 70, who, after lon[g] and wearisome work, raised his arm to tak[e] off his hat, and ruptured his left biceps. Cu[rio]usly enough 2 years previously this man ha[d] ruptured his right biceps while using the *co[up] de lapin*.

3. *Trauma*. (a) *Direct* trauma consists of a v[io]lnerating force exerted on either the arm or [the] shoulder. It may be a fall on the shoulder or a blow on the arm. Of all the cases reported by Loos, according to Keen, only 4 ruptures of the muscle and one of the tendon were caused by muscular effort. In this series 19 resulted from direct force.

b. *Indirect*. By this usually is meant the sudden brusque contraction of a muscle. In this group I include those cases of rupture occurring in young athletic persons with healthy shoulder joints who, as the result of sudden and often unexpected and uncoordinated movements, snap their muscles or tendons. Immediately there is severe pain, disability, extravasation of blood, swelling, and tenderness over the area. A fall on the shoulder, which would throw a great strain on the long tendon, may indirectly produce such a rupture. A reflex contraction of the biceps also may produce such a lesion, as in the case of Barthelemy. While cranking his car this man fractured his right radius. He also felt a tearing in his arm, and, at operation, a complete rupture at the musculotendinous junction was found. In my series 83 were caused by indirect force.

c. *Dislocation* of the shoulder may be a complicating and concurrent factor, with direct or indirect trauma, in producing a rupture.

B. Mechanism. Over a century and a half ago the immortal and versatile John Hunter (142) became interested in this subject, having sustained a rupture of his gastrocnemius muscle while dancing. Discussing the mechanism of a ruptured muscle he said in part: "A broken tendon usually arises from the power of a muscle being put into full action and a sudden resistance taking place at the same time." All authors recognize the rapidity of the contraction to a surprise movement as playing an important rôle in the rupture of tendons, though its mechanism is not very clear.

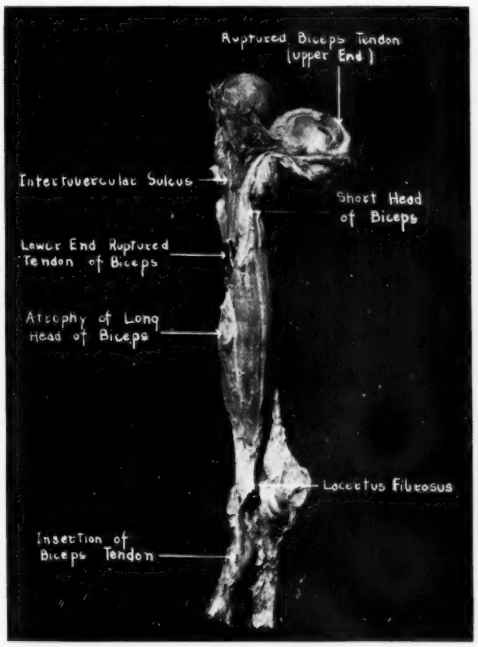

Ruptured Biceps Tendon (upper End)
Intertubercular Sulcus
Short Head of Biceps
Lower End Ruptured Tendon of Biceps
Atrophy of Long Head of Biceps
Lacertus Fibrosus
Insertion of Biceps Tendon

Fig. 11. A rupture of the tendon of the long head of the biceps, occurring intracapsularly a short distance from its insertion on the lip of the glenoid, and the retraction of the muscle and tendon. Found in a dissection of a cadaver. (Kindness of Dr. H. O. Knight, professor of anatomy, University of Texas Medical School, Galveston, Texas.)

I believe that when a rupture occurs the muscle is in strong contraction, and the group of antagonistic muscles suddenly and unexpectedly are brought into action, and that there is always a lack of muscular balance or adjustment. In this series in 32 instances the patient was lifting about 150 pounds with his forearms partly flexed and his biceps in strong contraction. At the instant he elevated the object to a certain height he suddenly erected his body in a strenuous effort to throw the load up or over his shoulder. Thus this sudden pull of the trunk muscles, which are so powerful, produced the tear or complete rupture. As the force is from above in these cases, I believe the lesion occurs in the upper end of the tendon.

Fig. 12. Partial rupture occurring in lower tendon of the right biceps. Note bulging of muscle in the upper third of arm with corresponding flattening in the lower third.

How an intracapsular rupture may occur by purely mechanical means has been explained in great detail by Ludington on the basis of leverage and from this, he concludes that, "it is reasonable to suppose that a rupture above the groove may be attributed to muscular effort alone."

C. Tensile strength. Relative to the tensile strength of the healthy tendon of the long head of the biceps, Keen agrees with Davis (47) that a true rupture of this tendon is much rarer than generally is supposed, and that, when it does rupture, it usually is because of disease. In the majority of cases I am certain that this is true, but there are frequent exceptions, as I have proved (71) at operation (Cases 1, 5, and 8).

From my clinical experience, I estimate the tensile strength of this tendon to be about 150 pounds. Meyer, in arriving at its tensile strength, used a good machine and a gauge and found it to be from 150 to 200 pounds in 10 old subjects (132). This, of course, was not carried out on living tendon.

According to Thiel and Minot (189), certain gymnastic exercises produce a different quality of muscles, for example, training with light weights and rapid movements produces muscles with less tendency to rupture than does training with heavy weights, fixed bars, etc., which tends to produce fragility of the muscular fibers; thus the muscles of a boxer are different from those of a wrestler.

D. Sites and types of rupture. The site of the rupture may be at its cartilaginous attachment with the glenoid, in the capsular portion of the tendon, in the extracapsular portion, in the muscular portion, usually in the middle, more rarely in the upper or lower third, at the musculotendinous junction, or in the lower tendon, usually at or near its insertion on the radius.

According to most writers, about 6 per cent of ruptures are believed to occur in the muscular substance. This estimate can be only theoretical as no one, to my knowledge, before this study had tabulated sufficient cases to render an opinion.

Loos (121) has written that 43.6 per cent occur at the junction of the muscle with the tendon; 36.9 per cent in the muscle proper; and 19.5 per cent in the tendon of the long head. He stated that if ruptures occur in the tendinous portion it is always in the long head and never in the short head. Many writers assert that the short head is never ruptured by indirect force. On the contrary, in my series, 2 were in the short head.

Of the 3 parts constituting the biceps, Bianchieri has reported that the long head is most frequently affected (96 per cent), next the lower tendon (3 per cent), and least of all the short head (1 per cent).

I have found in the literature only 19 cases of rupture of the lower tendon. I am adding 3 more from this series, Holcomb's, Simpson's, and mine.

Some writers claim that the rupture of a tendon is always total while the rupture of the muscle may be partial or complete. However, in 2 of my patients, Cases 2 and 3, the rupture of the tendon was not total, each patient having about one-fifth of the tendon remaining. I can find no report of cases similar to these two. It is these partial ruptures of the tendon that are the most difficult to diagnose and are, therefore, most often overlooked, because there is very little, if any, bulging of the belly of the muscle. As these patients have pain in the shoulder joint they are treated nearly always for arthritis (Figs. 7 and 9).

In my series of cases, the proportion is:

Fig. 13. Tumor (lipoma) in region of right biceps which should not be mistaken for the bicipital syndrome. (Kindness of Major White and Dr. Robert Jones, Marine Hospital, San Francisco.)

	Cases
Rupture of entire muscle, complete	6
Rupture of entire muscle, partial	1
Rupture of muscle of long head, complete	3
Rupture of muscle of long head, partial	5
Rupture of muscle of short head, complete	1
Rupture of muscle of short head, partial	1
Hernia of muscle	1
Rupture of tendon of long head: disinsertion from glenoid	9
Rupture of tendon of long head: intra-articular portion (4 bilateral)	34
Rupture of tendon of long head: extra-articular portion (1 bilateral)	14
Rupture of tendon of short head (1 also had a bilateral rupture of long head)	2
Rupture of upper musculotendinous junction	20
Rupture of lower musculotendinous junction	2
Rupture of lower tendon, lower attachment	3
Rupture of lower tendon, tendon itself	1
Lipomata	2
Fibroma	1
Total number of lesions (Less 5 bilateral, 1 of which also had a rupture of the short head)	106
Result of direct violence	19
Result of indirect violence	83
Total number of ruptures (Less 5 bilateral, plus 3 tumors)	102
Operated upon	73
Not operated upon	24
Treatment not reported	3
Total number of cases	100

In the rupture of the long tendon of the biceps, according to Ledderhose (110), who in 1909 was the first to differentiate them, one must consider two types of ruptures, the high and the low.

1. The *high type*, or intracapsular rupture, includes the disinsertion of the tendon at the level of the tuberositas supraglenoidalis (Fig. 10). It is the usual type, and ordinarily is a manifestation of dry arthritis of the

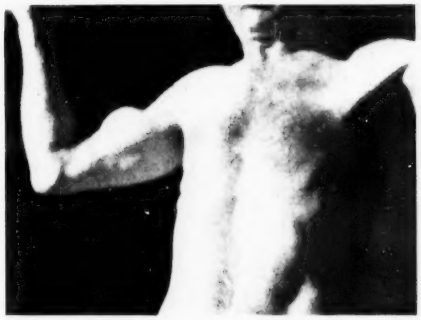


Fig. 14. Tumor in biceps region. At operation dense fibrous tissue was found at upper musculotendinous region. (Kindness of Dr. J. B. Levinson, San Francisco.)

shoulder (110). At the level of the ruptured tendon one may notice a hæmatoma, or a hæmorrhagic infiltration, which after a few days, becomes superficial, and again one may observe no hæmorrhage. The presence or absence of hæmorrhage may be explained by what was said about the circulation of the tendon, and by the fact that a final rupture may be preceded by partial and successive ruptures of different fibers of the tendon, as occurs in late rupture, so that the final accident affects only a few fibers too small to produce ecchymosis or pain.[1]

2. The *low type* consists of those ruptures which occur at the level of the bicipital groove, at the union, or slightly below the union, of tendon and muscle (Fig. 11). In this type the deltoid depression is very marked. The tendon is perceptible for a great part of its length, and the tumor is reduced little with passive extension of the arm, while under active contraction it hardens but never becomes relevant, nor does it become immobilized completely; and last, which is an essential character, as the tendon does not bear the effectual traction of the muscle which contracts, it no longer gives the sensation of a stretched cord which vibrates under the finger (15). (Fig. 7A, Fig. 9a, and Fig. 10A.)

On comparing the two arms one can see, on flexion, how the ruptured muscular belly

[1]Fievez (61), evidently without knowing of the preceding work of Ledderhose (110), came to the same conclusions. Since his publication of 1914, Lapointe reviewed the literature and recorded that out of 13 cases, 11 showed the site of rupture to be intra-articular. To him this percentage seemed to confirm the opinion of Ledderhose (110) and Fievez (61).

retracts lower than the uninjured one. In this series there are 2 cases of simultaneous bilateral rupture of the lower type. In the literature I have found 4 cases reported.

These ruptures, according to Bera (15), also may be classified as to their development into 3 types; (1) acute, (2) latent, and (3) intermediate or what is equivalent, subacute. The area where the rupture occurs presents a fascicular dissociation of the tendon, as has been found in the cadaver by Meyer (129).

1. The *acute type*, also referred to as traumatic or immediate, results from a direct or an indirect cause, and occurs when the various anatomically and physiologically independent fasciculi are broken in rapid succession so that the entire tendon suddenly ruptures. In these cases the pain in the top of the shoulder is so intense, the functional disturbance so great that the injured person is disabled immediately and usually seeks medical attention at once.

2. The *latent type*, also referred to as medical, tardive, or senile, is the most frequent but is seldon recognized as such in the literature. In this type the tendinous fasciculi break separately and at various intervals of time; the slight peritendinous reaction, to which the worker is constantly subjected over a long period, is produced as the fasciculi tear and is followed by adhesions sufficiently strong to hold the tendon so that the person remains unaware that a solution of continuity of his tendon has occurred and continues with his occupation (15). It is not surprising that this type is not recognized or diagnosed by the attending physician who treats the patient for a sprain, arthritis, or a bursitis, etc. The traumatic origin of these cases is not excluded because, in some cases, the pain and impairment are slight and the patient gives little heed to them as hard work has accustomed him frequently to having sore muscles.

3. The *intermediate or subacute type* occurs occasionally when a muscle or tendon is subjected suddenly to a jerk or an incoordinated movement, so that only a certain number of fibers tear with resulting slight pain and transient functional disability (15).

E. Symptoms. The symptoms vary according to (1) the condition of the tendon (healthy or unhealthy); (2) the cause (proportion or non-proportion between cause and effect, that is trauma or muscular effort and ruptures); (3) the site of rupture (tendon, belly, or junction); (4) the type of rupture (complete or incomplete, acute, intermediate, and latent). The symptoms are classified as:

Subjective symptoms.
- A. Variable. (1) Pain, (2) Snap (audible, etc.).
- B. Constant—weakness.

Objective signs.
- A. Inspection.
  1. Shoulder. Shape may be altered.
  2. Arm. (a) Tumor. (b) Hollow (hiatus). (c) Ecchymosis. (d) Swelling of contracted muscle above (swelling and ecchymosis may not be present).
- B. Palpation.
  1. Tumor.
  2. Hollow.
  3. Softening of muscle (in whole or in part).
  4. Loss of its elasticity.
  5. Abnormal perceptibility of the tendon.
  6. Tension of the tendon which gives the two types (high and low).
  7. Function—impaired.

If the rupture occurs in a healthy or fairly healthy tendon, the patient usually feels first a sharp pain in the top of the shoulder, which extends down the anterior portion of the arm to the elbow. Some hear and feel a sharp snap, like the crack of a whip or the blow of a cane, which may be audible several feet away.

If the rupture occurs in a tendon already altered by disease or by previous, consecutive, unnoticed traumata which have frayed it, the final rupture may occur without the knowledge of the patient. His only complaint may be that of weakness of the arm or a vague feeling of discomfort in the shoulder which he readily attributes to "rheumatism," a slight sprain, or a bruise.

The shape of the shoulder, according to White, is considerably altered, as the head of the humerus, not being held down by the long tendon, is approximated more closely to the acromion. I have not found this striking difference.

If the rupture occurs in the tendon of the long head and is complete, the belly of the muscle will be drawn toward the elbow and will bulge in the lower third of the arm (Figs. 3 and 6); if it occurs in the lower tendon the tumor (bulging) is seen, of course, in the upper third (Fig. 10) as the whole muscle will be

drawn up toward the shoulder. The volume of the tumor depends to a great extent on the degree of patient's muscular development, and varies from the size and shape of a pigeon's egg to that of an orange. When the arm is extended passively the tumor becomes smaller in size but does not disappear. The tendon of the long biceps is seen before it passes under the anterior border of the deltoid. The presence of this cord and of this tumor alter the usual appearance of the anterior brachial area. Instead of the ovoid contour of a normal biceps an asymmetrical bulging is seen in its superior portion. The alteration in the muscle of the long biceps renders its twin muscle, the short biceps, more prominent than it normally is and it stands out alone, a hollow beside it, instead of its companion muscle.

If the rupture occurs in the muscular belly and is complete, the two ends retract and separate, and a hollow or hiatus may be seen, especially on contraction of the muscle. If the rupture is only partial, the groove may be less visible and, at any rate, it will depend on the extent of the separation of the muscular fibers. This hiatus widens on extending the forearm passively or against resistance. The patient complains of weakness which is more or less pronounced according to the site and extent of the rupture, that is, tendon or belly, and whether it is complete or incomplete.

There may be an extensive ecchymosis in the region of the biceps, especially in lesions of the muscular belly, but this discoloration may be absent in lesions of the tendon.

With the arm at rest, the tumor is felt to be soft, mobile, and not adherent to either the skin or the deeper tissues. Under active acute flexion of the forearm, and especially if the flexion is performed against resistance, the tumor enlarges and hardens. There may be some tenderness on pressure, and at times more or less pain, especially if the rupture occurred in the muscular belly. Occasionally because of pain this swelling has been mistaken for an abscess and incised. If the interruption of continuity is in the muscle belly, there is an immediate hæmorrhage, and the two ends of the muscle retract; a hollow sometimes can be observed and a notch felt between the ruptured portions, if the patient is seen immediately before the formation of the hæmatoma. In this notch the humerus can be felt beneath the skin. This furrow can be widened by extending the forearm. Naturally, following the hæmorrhage, there is often a rather extensive extravasation of blood and ecchymosis, and the discoloration may become pronounced. Besides the humerus, which is felt in this notch, the palpating finger feels the unnatural softness of the muscle because of its having lost its elasticity.

The abnormal perceptibility of the tendon of the long biceps felt under the anterior border of the deltoid is of prime diagnostic importance, for ordinarily the tendon ceases at this junction and loses itself in the increasing spindle belly mass (15). However, in this condition, 3 or 4 centimeters of the tendon are palpated under the deltoid margin. Occasionally it may be felt tightly curled up, like a watch spring, deep beneath the upper end of the muscle belly, as in Figure 6.

The tension of the tendon, under active or passive contraction of the arm, varies according to the anatomical site and clinical type of bicipital syndrome. The primitive lesions of the tendon or its consecutive modifications may be such that they comply entirely with the tonicity and the elasticity of the muscle. In the low type, which can be diagnosed from a distance as the muscle retracts to its maximum, a very marked subdeltoid depression and a perceptibility of the tendon for a greater portion of its length will result. The muscular tumor will scarcely reduce under passive extension of the arm, while under free or opposed active contraction it hardens, but it does not bulge more nor does it become completely immobilized. And, finally, which is an essential character, the tendon not receiving the efficient traction of the contracting muscle, will not give the sensation of a stretched cord which raises the skin.

This type, in which the contour of the arm is very much modified, is contrasted to the high type which has inverse characters.

A tear, or a partial rupture, can be diagnosed as a soft, oval, small swelling, which, during contraction of the muscle, changes its position and becomes harder.

The impairment of the function depends on the severity of the trauma and on the site and extent of the lesion. It may be insignificant and transient, as in the intermediate type; very disabling, as in the acute type; or variable, as in the latent type. Therefore, one may find any degree of impairment from a slight weakness to a severe loss of function, as in the rupture of the tendon of insertion, when flexion and supination of the forearm are definitely affected.

DIAGNOSIS

A thorough consideration of the symptoms of the bicipital syndrome will often render the diagnosis less difficult. The onset of the disability may be sudden or gradual, thus permitting a diagnosis of acute, latent, or intermediate type.

The symptoms which accompany the disability, as well as the type of onset and the immediate or remote cause of the syndrome (trauma or disease) are very valuable. We must remember that they are subjective and objective.

These are detected easily, by inspection of the shoulder and arm (shape, deformity, abnormal tumor, hollow, tendon and immediate or late ecchymosis); by palpation which confirms the site, shape, volume, elasticity, and hardness of tumor, abnormal perceptibility of the tendon, of the hollow, and of the humerus; and by examination of the function which is more or less impaired.

The active and passive movements of the forearm and a comparison of the injured with the uninjured limb will accentuate all of the foregoing signs and symptoms, thus facilitating the diagnosis of a high or low type of bicipital syndrome.

Hueter's sign (96), flexion of the forearm in pronation when the biceps is tense, is more forcible than when the forearm is supinated and the biceps is relaxed. In the pronated forearm, the radius crosses the course of the ulna in such a manner that it can be supported in the movement of flexion of the latter, and the radius is moved in the direction of flexion with very slight exertion. On flexion of the supinated forearm, even though there is nothing to overcome but gravity, one feels at least that the biceps swells. As flexion in pronation is well known, as a rule, to be completed exclusively through the brachialis anticus, the belly of the biceps muscle remains soft and flabby. In very energetic movements the biceps muscle also contracts in flexion of the pronated forearm, but there always remains noticeable, in a similarly strong complete flexion of the supinated forearm, a striking difference in the flexion of the muscle. Clearly a contraction of the biceps in the pronated forearm must produce always a movement of supination immediately afterward.

Yergason's sign (203), also spoken of as the supination sign, is described as follows: "If the elbow is flexed to 90 degrees, the forearm being pronated, and the examining surgeon holds the patient's wrist so as to resist supination, and then directs that active supination be made against his resistance, pain, very definitely localized in the bicipital groove, indicates a condition of wear and tear of the long head of the biceps or synovitis of its tendon sheath."

Ludington's sign (122). The patient is directed to rest his folded hands palms down, on the top of his head and allow the interlocked fingers to support the weight of the arm. In this position there is a maximum relaxation of the long head. The examiner then places two fingers on the tendon of the long head of the biceps, and directs the patient to contract and relax the biceps muscle simultaneously. The contraction of the tendon of the long head on the sound side is felt plainly, while it is absent on the affected side if the tendon is ruptured, or is felt less readily if the tendon is elongated.

DIFFERENTIAL DIAGNOSIS

Proceeding from the surface to the lower structures, a tumor simulating a rupture may be superficial to the fascia or may be deep. The condition of the aponeurosis should be remembered, as pointed out by Pichon, who in 1907 wrote a classical article on the subject.[1]

Muscular hernia, caused by a rent in the aponeurosis, is very rare and usually is the result of a direct penetrating trauma, such as

[1]Until the appearance of this article almost no one had given any consideration to the importance of the aponeurosis to the rupture.

a stab wound. Lexer distinguished between the hernia of injured muscle and the hernia of ruptured muscle; in the former the muscle will bulge through the rent in the fascia only in the relaxed state and will disappear on passive extension or when contracted. On the other hand, the injured muscle bulges more during contraction than in the state of repose. But this latter instance is what the authors call a pseudo-hernia of the muscle. Case 63 of this series is a very striking example of a strangulated muscular hernia (58).

Pseudo-hernia of muscle is a muscular rupture, together with a rent in the aponeurosis. According to Lejars this designation is merely clinical. The condition is rare. The case of Lagueu, reported by Pichon, is a typical one.

Lipomata and fibromata which arise in the anterobrachial region may be confused with ruptured biceps (Figs. 13 and 14). Their consistency and the fact that active contraction does not alter them, and that other signs of rupture enumerated in the preceding chapters are also lacking, usually make it easy to rule out these tumors. At times, however, it may be difficult to diagnose a subfascial lipoma, as in Case 40 of this series in which the history was typical of rupture of a tendon, and the lipoma lay over the biceps and, on flexion of the forearm, became prominent thereby simulating a rupture (67).

In subdeltoid bursitis the pain and tenderness are localized in the region of the bursa and are increased by active or passive external rotation and abduction. None of the principal objective signs of the bicipital syndrome is present.

For a detailed description of acute rupture of the supraspinatus the reader is referred to the splendid article of Codman, who has written extensively on this subject. A rupture of this tendon is more serious than a rupture of the biceps alone and extremely disabling if the two are combined.[1]

A differentiation of the various entities which form the bicipital syndrome is simplified, if one remembers, as Bera pointed out, that the low type eliminates both the dislocation and the elongation of the tendon.[2]

[1] I do not agree with Codman that "rupture of the long head of the biceps alone is a trivial matter," as in many of my cases, especially those of acute rupture and more particularly those of partial rupture of the tendon, the symptoms were sufficiently disabling that surgical intervention was necessary. Considerable, if not complete, relief was obtained. Meyer's anatomical observations and my clinical and operative findings are in accord. Neither of us agrees with some of the statements of Codman. However, it is quite evident that Codman and Meyer have been considering two different entities; Codman, lesions of traumatic origin, Meyer, lesions resulting from attrition.

TREATMENT

Tears and ruptures. Many patients do not present themselves for treatment until days or weeks have passed. Often, if they do, they are treated as having sustained a contusion or a sprain, by the application of fomentations and liniments.

If the tear is not extensive, the arm should be immobilized in acute flexion for 2 or 3 weeks, at the end of which time healing should have taken place. Then the arm should be let down gradually and massage instituted. It is a mistake to begin massage earlier, as the friction will retard the repair taking place between the muscle fibers. After union has occurred, graduated active and passive movements should begin.

Occasionally, good functional results are obtained by such conservative measures but as Keen stated, often in the case of partial rupture loss of function is very marked. It seemed strange to him that surgeons have so rarely operated on these patients when one sees so many cases of impaired function in those not operated on and such good results in those operated on early. My experience leads me to be entirely in accord with Keen's opinion.

After all, it is upon an exact diagnosis that the choice of treatment depends. Incision in the arm should be made where one expects to find the lesion. In case of doubt, an exploratory incision under local anæsthesia can do no harm and later may prevent embarrassment to the attending surgeon. If the long head is ruptured at its attachment to the lip of the glenoid or near its upper end, one of five methods may be chosen: (a) suture of the ruptured tendon to the tendon of the short head of the biceps (2 and 12); (b) suture to the coracoid process (137); (c) suture to the pectoralis major (89); (d) suture in the sulcus inter-tubercularis (17, 108, 162); (e) suture into the deltoid. I believe that in most in-

[2] For a more comprehensive discussion of the differential diagnosis of elongation and dislocation the reader is referred to my subsequent paper, in which this aspect of the bicipital syndrome will be discussed in detail.

stances it is better if the two methods (a) and (b), are combined as I have done several times (71 and 72). (Fig. 7,B, Fig. 9,b, and Fig. 10,B.) The tendon of the long head of the biceps was slipped through a portion of the short head near its attachment to the coracoid. It then was fastened to the coracoid process beneath its periosteum, and the fixation was fortified by 4 sutures in the tendon of the short head, where it had emerged. This method has the advantage that, if the new insertion on the coracoid process should give way, there still remains a good, firm, high attachment on the upper tendon of the short head.

The intra-articular suture of the two ends is such a serious surgical procedure, fraught with such hazard, that I believe it should not be attempted and is, in fact, unjustifiable in view of the perfect results which are obtained by the method just described. An easier way and one which is useful in case the tendon is too short to insert on the coracoid process is to roughen the floor of the sulcus intertubercularis and to attach the tendon directly in the groove. This can be done in two ways, either by fixation of the tendon directly in the groove, or by splitting it and fixing it firmly through holes made in the side of the sulcus(27).

When the ruptures occur in the middle of the tendon, overlapping and suturing often suffice, provided the tendon is not frayed or has not undergone too much degeneration. If these conditions are present, or if the rupture is at the upper or lower musculotendinous junction, it will be necessary to resort to a fascial transplant, preferably from the fascia lata, as in Case 5. If the rupture occurs in the muscle proper, in addition to suturing the muscle, one should overlap a large fascial transplant for reinforcement.

For the repair of a rupture of the lower tendon, two methods have been employed; fixation of the tendon on the radius with a nail, as performed by Kerschner; or if this is not possible, suture of the tendon to the neighboring soft tissues.

PROGNOSIS

The outlook depends on several factors. Among those to be considered are the entity which determines the syndrome, its type, the extent of impairment of function, and the age and condition of the patient.

A partial rupture or tear of the muscle, if not extensive, heals usually in a few weeks by conservative measures; if more extensive, conservative measures still may be indicated in a very limited number of cases. However, if the case is seen early and a sulcus can be palpated, or if the hæmatoma is large, it is unwise to delay surgical intervention. Early repair not only permits the patient to return to full activity weeks or months sooner but gives a much better ultimate functional result, as the muscular fibers do not degenerate so much and the amount of cicatricial tissue will be less (16 and 190).

A partial rupture or tear of the tendon, if not very extensive, and if occurring outside the groove may not prove very disabling. There is some soreness and aching for a few weeks, but recovery is uninterrupted.

A complete rupture of the belly of the muscle and of the musculotendinous junction requires early surgical intervention in order to prevent degeneration of the muscle and more or less ultimate impairment of function.

A complete rupture of the tendon may have a different outlook. This depends on the site of the rupture, and the extent and the time of formation of the adhesions consecutive to the rupture, which are the result of a traumatic peritenosynovitis and traumatic tenosynovitis. If the rupture is in the lower tendon or at either junction, usually only surgical repair will restore function. If the tendon of the long head ruptures completely, and if the case is seen early, immediate repair should follow. If seen late and if the adhesions have formed and are strong enough to hold the tendon, even though slightly relaxed, so that the muscle can contract effectively, the outlook is good for a restoration of function without operation.

MEDICOLEGAL ASPECT

Ludington believes that cases of rupture within the groove are spontaneous, while those out of the groove have a history of trauma. This view, if correct, would simplify the problem very much; however, after analyzing

100 cases, I am not in accord with him. Ewald believes that industrial liability should be accepted only when there are: (1) a history of recent trauma, (2) immediate symptoms of injury, and (3) impairment of function.

Liniger (119), Pichler, and Ledderhose (110), are of the opinion that rupture of the long head of the biceps is not an accident of labor but the result of an articular condition (arthritis). The two latter believe that compensation for disability should be paid only for repair.

Many cases of ruptures, reported in the literature, are the results of accidents (108). In this series, a number of cases are indubitably in this group.

From my cases and the others which compose this series of 100, there was no question as to the medicolegal aspect of many of them. Some were and some were not of industrial origin. It is highly important to all parties concerned that the surgeon, whose opinion is sought in these cases, has a clear idea of the underlying causes, the history of the accident, and the mechanism of production of the injury in order that he may be able to render an opinion which is fair and just.

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Discussion

DR. KELLOGG SPEED, Chicago: If from a clinical standpoint we may divide ruptures of the biceps brachii into those of the tendon of the long head, the short head, the muscle belly, and finally the tendon near the insertion into the tubercle of the radius, we have left only the rare dislocations of the tendon from its bed in the inter-tubercular sulcus of the neck of the humerus. Elongation of the tendon follows progressive partial rupture of either tendon or muscle. It may seem strange that the long head of this muscle, arising from the glenoid rim, should suffer frequent rupture, but the essayist's explanation of the anatomy, mechanism, and predisposition from age, wear, and tear, explain this accident. This rather powerful tendon is subjected to enormous leverage force during the act of adduction and forced elevation of the arm in trauma when its muscular portion is fixed in supreme contraction. Partial ruptures in occupations requiring movements classified under this cause lead eventually to shredding and progressive weakness until one day the proverbial last straw is applied by an excessive muscle pull, and the tendon completely separates.

Gradual rupture of the tendon is less explosive than the acute rupture from massive trauma which occurs in a sound tendon, yet the symptoms are similar while much milder in degree, lengthening of the tendon being merely the result of a long continued series of rupture of a few bundles of tendon at a time.

The acute pain, the feeling as if one had been shot or struck a sharp blow in the shoulder region with subsequent subcutaneous hæmatoma formation are common symptoms of muscle or tendon rupture anywhere in the body. One must not overlook, however, the chronic or progressive ruptures to label them as bursitis or some vague term which cannot be verified.

The acute muscle ruptures are striking. I have seen four. They all occurred in powerfully muscled normal adult men from surprise contractions in reaction to unexpected force usually applied on the

tensely flexed forearm with the arm abducted or brought forward at the shoulder. In these cases the pain is not very severe but the resulting hæmatoma forms rapidly and spreads down the arm beneath the deep tissues. Later atrophy of the muscle belly involved with weakness and visible deficiency are found.

Dislocations of the tendon are rare in my experience. One might expect them after the trauma of shoulder dislocation which must strain the long head greatly to retain its attachment to the glenoid and keep its continuity with the displaced belly in the arm. In light of the frequent occurrence of dislocation at the shoulder either this accident does not happen or it is frequently overlooked. In operation on this region of the shoulder I have always been impressed with the toughness and high grade sufficiency of the so called transverse humeral ligament. When the tuberosity of the humerus is fractured one might expect the dislocation to occur, but it has never been seen by me in operative repair.

Treatment depends on diagnosis. For acute ruptures of either tendon, for the acute complete muscle tears—early operation is certainly indicated. I would call your attention to the ease with which the Nicola operation for habitual dislocation at the shoulder may be applied to many instances of ruptured or dislocated tendon. With the hole drilled in the humerus adequately large to contain the tendon and immediately underlying the inter-tubercular sulcus, the severed tendon can be threaded through and reattached to its upper end no matter how short the proximal fragment may be. The tendon lying thus in a freshly exposed bed of bone takes on early firm adherence and a new attachment, physiological in character and direction, complying to all laws of tendon attachment into the bone. For dislocation of the tendon no cure could be simpler than this.

Following the Nicola operations I have performed the functional return in the biceps muscle and arm as a whole has been most satisfactory. This operation consequently I recommend to you with assurance after my experience with it. The ease and neatness with which it can be performed obviate much dissection or attempt to transplant wounded tendon into neighboring tendon or muscle. In ancient cases, deficiency in the tendon may be supplemented by grafts of fascia lata rolled into suitable size.

DR. PAUL B. MAGNUSON, Chicago: Injuries around the shoulder, like injuries in the lower back, have always been more or less confusing in their symptoms. Dr. Gilcreest has called our attention to a condition which I think few of us have recognized, or even looked for. We have all seen ruptures of the biceps of the arm when they occur in the muscular portion, but I think the condition to which he calls attention has been almost completely unrecognized by the clinician. The subdeltoid bursa has been blamed for most conditions which exist chronically in the shoulder and give pain in the region of the head of the humerus. Careful examination, having constantly in mind the anatomy of the parts examined, will, in most cases, bring out the differential points between subdeltoid bursitis, rupture, or partial rupture of the tendons of the long head of the biceps, arthritis, or infections or toxæmias which cause inflammatory processes of the muscles around this region.

The mechanism of the shoulder is complicated so far as the muscular attachments are concerned; the shoulder joint itself is a simple piece of mechanism with a very loose capsule, and most conditions which cause pain around the shoulder are not due to injury to the joint itself, but are due to an inflammatory process of the periarticular structures. There should be one constant symptom at least for rupture of the tendon of the long head of the biceps, and that should be weakness of the biceps and pain when tension is put upon this muscle. Abduction of the arm should not cause pain, because the biceps is relaxed. The pain should be anterior to the usual location of pain caused by subdeltoid bursitis. By the process of elimination one can test each separate muscle or group of muscles in the shoulder, not forgetting the acromioclavicular joint, the tendons of the triceps, the attachment of the supraspinatus, infraspinatus, and teres minor to the greater tuberosity, nor the broad attachment of the subscapularis, apparently to the lesser tuberosity, but actually to the whole anterior surface of the head of the humerus and the capsule.

We are indebted to Dr. Gilcreest for his thorough and learned discussion of this subject, and also for calling our attention to an entity which I believe, as he does, has been frequently misdiagnosed or overlooked.

TRANSURETHRAL SURGERY[1]

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TRANSURETHRAL surgery is the mother of modern urological practice and has reflected its influence to other phases of medical science.

When one considers the tremendous benefits which have been derived through its application during this century there is little wonder why we should be justly proud of its accomplishments. The accumulated knowledge of the physiology and pathology of both the upper and lower urinary organs which has been afforded through years of sedulous effort in its adaptation and the innumerable therapeutic achievements which have eventuated have substantially transformed urological practice.

The fortunate accessibility of the urinary organs to scientific investigation and the response of the medical mind with the creation of instruments of precision and the provision for studies of variations in the physiological function, have led to the development of one of the most exact sciences in medicine. For instance, the simple urethral catheter, aside from saving numerous lives, has added comfort to millions through the mechanical relief of retention, has also elucidated the varied effects of urinary obstruction upon the bladder and kidneys and has given us in conjunction with certain laboratory determinations the most intimate knowledge of the secretory capacity of the kidneys. This knowledge of drainage has been applied to other organs in the human machine. The precise information gained through cystoscopic investigation of the bladder and kidneys needs no exhaustive description on this occasion, it has revolutionized our concepts of urological disease. The accessory attachments for operative manipulations have completely disrupted the customary canons of urological therapy.

The protection which transurethral manipulations have afforded the kidneys in the relief of infection, stasis, technical expulsion of stone, relief of certain hæmaturias, and the correction of drainage defects along the ureteral canal, proclaims its effectiveness. It has not been many years since renal destruction from extensive infection was a frequent demand for nephrectomy; today it rarely demands it because of the correction of early renal infections through transurethral manipulations.

In turning our attention to the bladder an even greater feeling of gratification arises since the relief of the majority of pathological changes in this organ from open surgical operation through the substitution of transurethral manipulative agencies has been colossal. The vast majority of bladder tumors and stone can be and should be treated endovesically. I have personally opened but one or two bladders in a number of years for neoplasm and likewise have been compelled to resort to open surgery in but a few instances for vesical calculus. Other less common and more simple affairs, such as obstructions at the lower end of the ureter, ureterovesical cysts, foreign bodies, and ulcers are almost universally attended to in this manner and finally we find ourselves applying such surgery with great effect and little peril to the most frequent pathological condition affecting this organ, namely, vesical neck obstruction. I have for 12 years broadcast to the profession the beneficial effects of transurethral surgery as applies to the removal of prostatic obstruction, but it has, until recently, been averse to release prostatectomy, one of the standard operative performances in surgery. Acquaintance softens prejudices but it often requires a long time to mellow the medical mind against any transgression from the accepted tenets of medical practice, particularly when it has been of such revolutionary nature as to disturb the tranquillity of the orthodox and it will in the future just as it has in the past meet with stern opposition and skepticism. Operative procedures receive a challenge from time to time when inquisitive minds question the beneficial results achieved by their performance. We are all witnessing very decided reactionary

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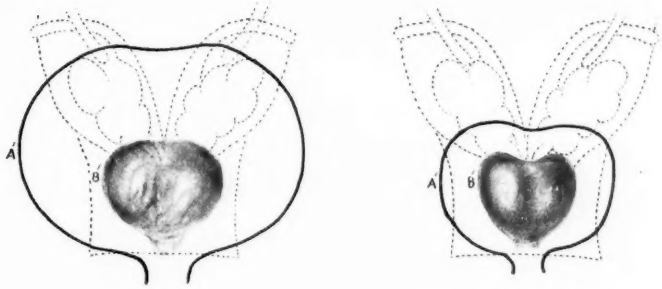
changes in surgery which bid fair completely to supplant certain previously accepted surgical methods and which have led to the development of others more adaptable for the purpose.

It would be a difficult task for one to prescribe a well defined, unimpeachable method of attacking the obstructing prostate since individual preference and the personal equation, swivel chair opinions, and synthetic surgery register such potent qualifications. There are surgeons today who still believe that practically all prostatic obstructions should be removed by open operation, others who insist that transurethral surgery is capable of effectively relieving all such obstructions, and there are many others who are more pliable and concede certain prostates of larger dimensions to open surgery and relegate the majority to transurethral methods.

There can be no question that either the open operation or the closed procedures can remove practically all prostatic obstructions, and it appears to me after many years of concentration upon this important subject that it is simply a question of balancing accounts of the results secured and the mortality rate obtained in the hands of surgeons who can competently do both. In order that transurethral surgery supplant major procedures it must be demonstrated to be effective in completely removing the obstruction without the hazards, complications, and high mortality rate which attend open prostatic surgery. This I feel has been amply proved in the last few years of transurethral application.

Conservation has become the keynote of modern surgical attack in urological practice. Ten or even five years ago nephrectomy was generally accepted as the preferred treatment for hydronephrotic kidneys but now plastic surgery has come to our aid and these organs are no longer excised promiscuously unless they can be demonstrated to be nothing more than functionless masses. Likewise, the modern approved methods of surgical relief of prostatic obstructions have been slowly evolved and perfected. Nothing deterred McGill from expounding his principles despite the unswerving opposition of Guyon and Thompson who still clung tenaciously to the theory of irreparable bladder atony. The initiative in transurethral surgery was taken by Guthrie in 1830 who stated, "that the object is to divide the bars or strictures at the neck of the bladder with as little injury as possible to the neighboring parts." This statement dogmatically expresses in brief the keynote of modern surgical practice relating to the treatment of prostatic obstructions. The eager desire for an optimum surgical result with coincident minimum sacrifice of healthy tissue has prompted the institution of less radical procedures than those hitherto employed for their correction. Since Guthrie's day, over 100 years ago, varied and diverse procedures have been perfected and the pendulum has swung rather precipitously both in the direction of extreme radicalism prompted by the overenthusiastic zeal of surgeons who favored bolder methods for the correction of the malady and in the other direction favoring extreme conservatism with relegation of the patient to a catheter life. Obviously there must be a happy medium and the avidity with which the transurethral approach of prostatic resection has been adopted testifies to its indisputable efficacy for the correction of obstructive prostatism.

Many illustrious names in surgery share in the development of this field of scientific endeavor but to mention only a few would be doing the others a grave injustice. I will therefore avoid tiresome repetition by acknowledging in brief the contributions to transurethral surgery in the last century by Mercier, Civiale, Leroy d'Etiolles, Bottini, Freudenberg employing crude instruments most of which were poorly adapted for this work. At a later date revolutionary changes were made both by Wossidlo and Goldschmidt in Europe and in this country by Wishard and Hugh Young. The last 25 years have seen the perfection of highly technical instruments, the creation of inventive minds, which have served to elevate this procedure to the pedestal of perfection which it at present so rightly deserves and among these the contributions of Braasch, Geraghty, Beer, Stevens, Bugbee, Bumpus, Maximilian Stern, Collings, McCarthy, Kenneth Walker, Luys, Foley, Kirwin, Davis, Day, and Tolson de-



A. B.

Fig. 1. A, A' original size; B' after operation, marked diminution in gland after removal of less than $\frac{1}{10}$ of total amount of tissue. B, A' original size; B' after operation, diminution in gland followed removal of about $\frac{1}{4}$ of total amount of tissue.

serve more than passing mention but time restriction will not permit a more detailed account of their work. It is, indeed, gratifying to me to have shared in the progress in this field of surgery and in particular to have been the recipient of the whole hearted co-operation of the urological profession and their acceptance of my conceptions with respect to applicability of transurethral surgery for the correction of the larger type of prostatic obstructions. More than a decade ago I first summoned their attention to the indisputable efficacy of my cautery punch operation and the beneficial results to be derived by its performance, decreasing thereby the necessity for major surgical operative procedures. At the outset they willingly compromised with respect to a relatively small number of prostatic overgrowths, chiefly bars and contractures of the vesical neck but still grudgingly reserved the remainder and by far the majority of cases for open operation, but I am pleased to state after perusal of the data with which I have been recently furnished and which will be detailed later that their attitude has been appreciably altered and that greater numbers have now been found applicable for this surgical procedure. This revised conception of the curative and corrective effects of transurethral surgery has been made possible by improvements in structural detail of the instruments employed and its adoption in many instances by men who are qualified both by experience and training in its accurate and detailed performance. The transurethral route of attack on the prostate can fulfil all the criteria demanded of an acceptable surgical procedure, e.g., simplicity of operative technique, applicability, freedom from complications and disabling sequelæ, negligible mortality rate, and above all uniformly satisfactory and lasting results.

A "new deal" was offered through the medium of transurethral surgery, not only to the senile prostatic whose life was fast ebbing away and who was unfit by virtue of his declining years and uræmia-racked constitution to withstand the exigencies of open operation but also the individual who had reached the life peak handicapped by prostatic obstruction but who was in all other respects a healthy and valued citizen of society. We offered them in lieu of major surgery, which in less experienced hands than the members of this august body had been attended with a high mortality rate, the benefit of a relatively simple perurethral operation associated with negligible surgical risk. In well qualified hands this procedure has fulfilled the requirements demanded of it but when undertaken by those who were ill equipped by training and experience it has failed and in many instances has been the indirect cause of death. Although these men cannot be justly accused of wanton or wilful neglect, the issue at stake has to my mind not been appreciably altered. I wish to reiterate at this point, and in so doing with the knowledge derived from lengthy practical experience and observation that if transurethral surgery is to be safe-

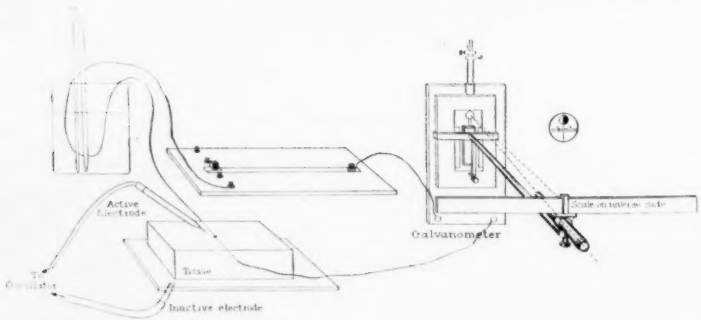


Fig. 2.

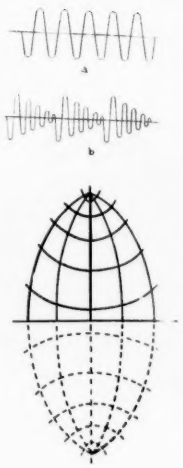


Fig. 3.

guarded from disrepute due to actions of those who are incompetent, it should be limited to use by those who are qualified by training and experience in its performance.

The indications, operative technique, and results achieved by transurethral resection of the prostate have been detailed on previous occasions and require no further repetition. In 1932, I reported an analysis of 781 cases, including 100 of the larger prostatic obstructions, 70 per cent being completely relieved by the cautery punch method for a period of 3 to 10 years and 22 per cent were sufficiently relieved to refuse further operative intervention. At the present time I have performed 900 transurethral operations with the cautery punch, the functional results continue to be extremely satisfactory, postoperative complications rare, and the operative mortality is about 1 per cent. I have repeatedly emphasized the necessity for repeat operations in preference to single prolonged sittings in order to spare the patients too frequently debilitated as a result of the obstructive dam in their bladder and the consequent impairment of general health from undue urethral instrumentation and the creation of large raw surfaces at the neck of the bladder with subsequent danger of hæmorrhage and toxic absorption, which serve to undermine both their general and local resistive and reparative forces. These factors still appeal to me as fundamental in the practice of transurethral surgery, oversight of which has unfortunately been followed by rather untoward complications and provision for which has eased the surgeon's conscience and materially affected thereby the continued well-being of the patient.

I observed at the very onset of partial prostatic removal in many of the larger growths that a pronounced retrogression and absorption of the remaining gland took place (Fig. 1); in some instances to an astounding proportion, in others not so pronounced. It was for this reason coupled with numerous other equally definite observations which I have repeatedly described and reported that I was assured of the inflammatory nature of these growths, contrary to the generally conceived neoplastic theory. I am still confident of this condition and it is the fundamental factor in transurethral surgery. This tendency to resolve under drainage urges us to allow Nature to aid the surgeon in these procedures and not to subject the patients to too extensive manipulations at any one time. This is a most important phase of transurethral surgery and, if deviated from, is likely to hamper its perpetuation. My firm belief in the inflammatory nature of the majority of these prostatic overgrowths prompted me in 1925 to suggest that the profession regard the prostate more seriously in the course of a general physical examination, not only by palpating its surface but by analyzing its expressed secretion. If evidences of chronic inflammation were revealed, immediate supervision

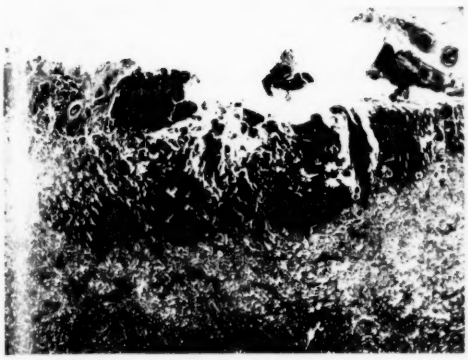


Fig. 4.

Fig. 5. Each bottle represents specimens removed from a patient at one sitting.

through adequate therapy should be undertaken as a means of prophylaxis against its future enlargement and with the development of early prostatism simple corrective measures should be applied. I predicted then that if this regimen were followed, it would take but a few decades to prevent the development of large obstructive prostatic lesions and coincidently the necessity for major surgical operations.

The pre-operative preparation of the patient for transurethral surgery demands the same meticulous care as do the patients who are to be subjected to open operation and also the same vigilant postoperative attention in order that the results we hope to achieve may materialize.

This paper is primarily concerned with a discussion of the nature of the physical agents employed for prostatic resection transurethrally and I willingly admit that a study of this phase of the problem has engaged both my colleagues and me for a considerable length of time. This study has been prompted and encouraged by a careful scrutiny and observation of the factors which were instrumental in promoting postoperative hæmorrhage, sepsis, and other complications and the comparative influence of different electrical currents on their incidence.

Beer, in 1910, was the first to employ high frequency currents by the endovesical route after witnessing the decided reaction of tumor tissue in the bladder to its application. Since that day various types of high frequency currents and contrivances have been developed and used both for bladder surgery and for the extraction of tissue at the bladder neck. It was primarily with the object of determining the destructive effects of these electrical currents on prostatic tissue that this investigation was undertaken, as well as of determining their comparative effects and if possible to ascertain with accuracy the most adaptable type of current for this very highly technical surgical procedure.

Although I hesitate to impress you by means of repetition, I do wish to stress the fact that my personal belief is that resection of the prostate by means of the cautery current which was first incorporated in my punch instrument is attended with fewer postoperative complications than a similar procedure employing the high frequency current. The cautery current seems to excise the tissue effectively and coincidently minimizes the danger of hæmorrhage and absorption from the resected site by mild surface coagulation. In order to satisfy myself as to the actual destructive effects of the respective electrical currents I undertook with the assistance of Mr. Wilbur Harris, whose knowledge of electrophysics was of inestimable value in this scientific study, an experimental and electrical investigation of the effects produced by various high frequency currents and the actual cautery current on experimental media animals and the human, and supplemented

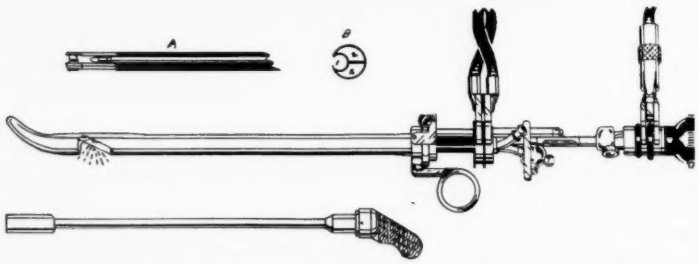


Fig. 6. New punch instrument complete. *A*, Section of working element showing disposition of telescope between irrigating channels and electrodes, semicircular blade at distal portion. *B*, Cross section of *A*.

these findings by a statistical survey of results achieved by these respective methods by members of the American Urological Association who very kindly furnished me with the data required.

In the past we have taken at its face value the supposedly harmless effect of electrical currents on tissue partly because of the reassurance of instrument makers who are only too eager to dispose of their merchandise and principally because we were rather fascinated and, may I add, possibly blinded by the thrilling fashion in which tissue could be removed by endovesical resection unmindful of the fact that the electrical display which we witnessed may have had a penetrating and even in some instances a decidedly destructive effect on tissues beyond our vision. We may have had a rather rude awakening when the patient unexpectedly developed a severe secondary hæmorrhage or began manifesting symptoms which we unwillingly had to ascribe to toxic absorption or the rekindling of a dormant pyelonephritis. We then began to ponder the possibilities of the problem and in turn attributed the untoward reaction to a breach in operative technique or the rapidity of instrumentation and consequent trauma to the urethra or to the use of heavy surface coagulation with the subsequent development of a slough. After all these causes had been carefully scrutinized and had failed to account for the eventuality of postoperative complications the possibility of the current, *per se*, began to loom as a formidable factor. It seemed propitious, therefore, that a more thorough and searching study of the destructive effects of various electrical currents be undertaken to determine their action in the promotion of postoperative complications.

The results of the following experimental studies have been reported in detail to the American Association of Genito-Urinary Surgeons in May. The experimental work was conducted with experimental media, heart muscle, fat, and fleshy tissue in animals and in the human directly with the prostate gland. After a preliminary study we were able to determine that the deleterious influences exercised by electrical currents were not the result of electrolysis or tissue destruction, the sequence of electrical vibration, but were the direct result of cumulative action of heat on the tissue. In order to determine with accuracy the heat penetration and propagation at fixed distances and with previously determined current values and time exposures, a standard thermocouple galvanometer was used to record the tissue temperatures (Fig. 2).

The thermocouple was placed at predetermined distances in the tissue away from the actual site of burning by the high frequency or cautery current to be tested and the temperatures developed at these sites were recorded at repeated intervals following application of the current. An effort was made in this study to reproduce as accurately as possible the maneuvers employed during the conduct of a transurethral operation, not only with respect to the strength of current applied and the duration of the application, but provision was also made for the cooling of the tissues so treated by constantly flushing them with a stream of running water.

Fig. 7. Showing position of instrument ready for cutting.

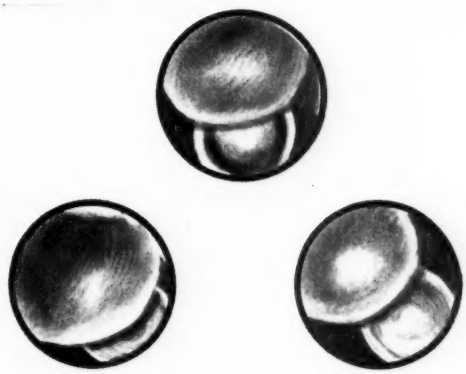


Fig. 8.

In the experiments carried out on the prostate *in situ* in man the thermocouple trocars were introduced into the depths of the prostate gland through the perineum in a manner similar to the perineal implantation of gold radon seeds, and with the suprapubic approach for both man and animal, these trocars were placed at precisely measured distances in the gland removed from the actual site of resection. We succeeded in proving to our satisfaction that with the high frequency currents generated either with the tube or gap type of generator most frequently employed in transurethral surgery, decided elevations of temperature were produced both in experimental media and the human prostate at points distantly removed from the actual site of resection and that the heat intensity varied proportionately with (a) the distance at which the temperatures were recorded away from the resection site, (b) the current value or strength, (c) and the duration of the application. The generation of heat in the tissues was not the result of conduction of heat waves but the effect of their accumulation in the tissues through which they were propagated between the active electrode at the site of burning and the indifferent electrode, being more intense at or near the site of resection (Fig. 3). With the cautery current, on the other hand, resection of tissue both in man and in the experimental animal was not productive of such pronounced heat generation in the tissues studied even after repeated current applications, e.g., at a point 0.8 centimeter removed from the cutting site seven repeated applications of the cautery current for a time interval of 3 seconds per application resulted in an elevation of tissue temperature of but 0.03 degrees C. whereas with a high frequency current of 500 milliamperes tension at a similar distance and corresponding application period of seven 3 second exposures, 13.2 degrees C. elevation in tissue temperature was recorded. We demonstrated on repeated occasions the tendency of high frequency currents to generate often exceedingly high heat intensities in the tissues studied. At a distance of 0.4 centimeter removed from the resection site employing a current of 900 milliamperes tension, applied for 2 to 3 second periods, a 25 degrees C. heat elevation was recorded in gelatin media. The same pronounced elevations of temperature were also produced and recorded both in man and animals following the application of high frequency or tension currents.

Appearances are often deceiving and this adage is not more strikingly portrayed than during the visualization of the cutting action of a loop charged with high frequency current. The apparent preservation of tissue within the confines of the loop has often created the impression in the operator's mind that the actual burning action is confined to the immediate vicinity of the loop's excursion during the act of resection and there is little if any heat penetration into the deeper tissues. The explana-

TABLE I.—COMPARATIVE TEMPERATURE CHANGES OF HIGH FREQUENCY AND THERMAL CAUTERY IN GELATIN

Time	Distance	Temperature change	
		High frequency	Thermal cautery
3 min.	0.4 cm.	8.67	0
		19.15	0
			0
			.189
			.610
			1.464
			1.953
			2.440
			2.730

Current value 900 ma.
Punch was heated from 3.5 volts.

TABLE II.—TEMPERATURES PRODUCED IN A TRANSURETHRAL PROSTATIC RESECTION EMPLOYING HIGH FREQUENCY CURRENTS

Temperature before cut C.	Temperature immediately after stroke C.	Duration of cutting stroke minutes	Current value ma.	Note
37.6	40.4	5	900	
37.70	40.53	8	800	4 min. pause
37.73	41.37	6	700	
37.70	40.08	12	700	Cutting high
38.01	41.37	7	800	
38.60	42.13	9	700	
38.64	41.08	8	800	
38.70	40.57	10	800	
38.70	40.58	8	800	
38.60	41.78	8	800	
38.30	41.06	8	750	
38.31	41.08	7	850	On lateral lobes
38.37	39.88	9	800	
38.31	65.73	5	800	Cutting near median portion
38.32	40.34	7	850	
38.14	41.88	6	900	Laterals again
38.14	51.23	7	850	Median incision

tion for this erroneous conception of the actual facts may be found when one considers that the tissue engaged within the cutting loop is beyond the influence of the heat paths generated by the flow of current between the active and indifferent electrode, and subjected solely to the heat derived from the conduction currents carried in the operating loop, whereas the tissues in the prostatic bed adjoining the immediate site of resection are subjected not only to the conduction currents in the loop but also and to a greater extent to the cumulative effect of heat waves generated in the tissue as a result of the current flow between the active electrode or loop and the indifferent electrode under the sacrum.

It is of interest to note that even with repeated applications of the actual cautery on experimental media and in man temperature elevations exceeding 3 degrees C. were seldom recorded. Table I demonstrates this comparative effect admirably. You will observe that a distance of 0.4 centimeter from the resection site following one 3 second application of the high frequency current of 900 milliampere tension value, a temperature elevation of 9 degrees C. was recorded by the instrument and the second application for a similar duration increased the tissue heat to 19 degrees C., whereas with corresponding distances and time applications but employing the cautery current, 4 applications failed to elevate the tissue temperature beyond 0.1 degree and it required 9 applications before a temperature elevation of 2.9 degrees C. was recorded.

Table II is very significant since it is a record of the temperatures developed in the human prostate during the conduct of high frequency resection for bilateral hypertrophy. The thermocouple trocars were introduced into the gland through the perineum and the temperature variations carefully recorded during the progress of the operation. Despite the fact that the actual cutting was primarily directed to the lateral lobes at points distantly removed from the direct path of the thermocouple trocars in the midline, definite elevations in the tissue temperature were repeatedly recorded which were due to conduction, and we are assured that a corresponding or even intensified accumulation of heat had occurred in the greater part of the gland and in particular that portion adjoining the resection site and lying interposed between the active and indifferent electrodes, since it will be noted that in the fourth line from the bottom and in

TABLE III.—TEMPERATURES PRODUCED IN A HUMAN PROSTATE BY APPLYING CUTTING CURRENTS FROM A 4 MILLIMETER COAGULATING BALL IN AN OPERATION PRELIMINARY TO PROSTATECTOMY

Temperature before application C.	Temperature immediately after—C.	Duration of application minutes	Current applied	Notes
.40	46.02	2	700	Water running, suction functioning
.00	45.26	2	700	
.72	47.25	2	700	Thermocouple approx. 2 cm. from point of application of current
.96	49.20	3	700	
.96	46.56	3	600	Interval between applications about 2 min. except in 2 cases where it was longer
.20	45.74	4	500	
.28	45.90	3	600	
38.36	47.55	4	500	
38.54	49.66	6	500	
37.4	42.1	1	1100	In rectum
42.1	43.2	1	1100	
39.3	63.0	1.5	1100	In prostate 1 cm. from application
40.2	51.9	1	700	
41.7	41.9	?	700	
41.3	50.5	?	700	

TABLE IV.—TEMPERATURES PRODUCED IN GELATIN WITH THE HIGH FREQUENCY CURRENT

S_1	S_2	Temperature change C.	Time	Distance from cutting loop to thermocouple	Current value
8	28	1.21	3 min.	1.5 cm.	900 ma.
	34	1.69			
3	38	1.94			
	53.5	2.84			
	59.5	3.35			
	68.8	3.95			
	75	4.36			
	86	4.94			
	91.8	5.47			
	99.2	5.92			
	105	6.31			
	113.5	6.87			
	122.8	7.48			
	127	7.74			
	134	8.10			
	139.8	8.58	Interval between current applications equals 10 seconds		
	145	8.92	Water running constantly for cooling		

the last line when the applications were made near the median portion that tremendous temperature elevations were recorded even as high as 28 degrees C.

Table III is a similar record but in this case the tissue temperatures recorded were those developed during the conduct of a suprapubic open exposure in which case the trocars were placed precisely at a distance of 2 centimeters from the site of burning. At this distance the tissue temperature was elevated 8 to 12 degrees C. following very brief application of the high frequency current. At a distance of 1 centimeter with 1.5 second application and the same type of current, an elevation in tissue temperature amounting to 26 degrees C. was produced.

Table IV shows the temperatures recorded in gelatin at a distance of 1.5 centimeters away from the point of application. At this remote distance from the point of application of current, with a short time exposure and allowing for cooling time, an accumulation of practically 9 degrees C. temperature is noted.

Table V shows a comparison of the high frequency current and the thermal cautery at a distance of 0.8 centimeter and illustrates the striking differences in the recorded temperatures.

Table VI is of particular interest since it records the tissue temperature during the conduct of the cautery punch operation. With the trocars placed in the gland at distances from the resection site corresponding to those employed for the high frequency resection, a tissue temperature elevation exceeding 2 degrees C. was never recorded. It is my belief, substantiated by the results of this investigation, that the heat generated in tissues during the course of the cautery operation, although but slight, is the result of conduction currents solely, since the current penetrates but a short distance into the prostatic bed, in marked contrast to the generation of heat in the tissues during the performance of high frequency resection which must of necessity be present to an appreciable degree throughout the substance of glandular tissue interposed between the electrodes. We

TABLE V.—COMPARATIVE TEMPERATURE CHANGES OF HIGH FREQUENCY AND THERMAL CAUTERY IN GELATIN

Time	Distance	Temperature change C.	
		High frequency	Thermal cautery
3 min.	0.8 cm.	3.21	0
		5.70	0
		7.80	0
		8.65	0
		10.10	0
		11.17	.001
		13.20	.003
			.120
			.214
			.354
			.502
			.708
			.915
Current value 500 ma. Interval between current applications 10 seconds			1.158

were also able to demonstrate that the application of current which resulted in very pronounced surface coagulation and necrosis was attended with but very mild generation of heat in the deeper tissues, indicating heat concentration at the active electrode whereas currents productive of superficial coagulation developed by 300 milliamperes tension value which is the equivalent of approximately one-third the current which is required for cutting, generated tissue heat to the extent of approximately one-ninth that produced by a corresponding cutting current.

The thermal death point of tissue cells is approximately 45 to 47 degrees C. A very significant fact revealed during the progress of this investigation was that the tissue heat generated following the application of the high frequency current was almost invariably incompatible with the continued cellular integrity. In the course of our experimental study, we made repeated histological studies of the tissue in the prostatic bed immediately adjoining and at distances remote from the site of resection. These findings have uniformly demonstrated three definite zones of tissue reaction following high frequency resections or applications: (a) A zone of tissue necrosis in the immediate vicinity of the burning site. (b) A zone of fragmentation in tissue further removed from the resection site in which the cells were devitalized and had lost their staining characteristics. The cellular nuclei were pycnotic and their cytoplasm showed evidence of vacuolization and fragmentation. There were also areas in which extravasation of red blood cells had occurred between the tissue cellular elements, and (c) the furthest removed sections approaching the normal prostatic tissue, in which the cells had undergone desquamation and also showed evidence of devitalization (Fig. 4).

I sincerely believe that we may attribute the incidence of secondary hæmorrhage and sepsis following high frequency resections to the erosive effect of late sloughs on blood vessel walls as a result of the penetrating heat effects of the current and consequent tissue damage. This cellular destructive effect has never been demonstrated during the course of our investigation with the cautery method of resection which is simply a superficial reaction.

With respect to electrophysics as applied to the human body, it has been more or less accepted as a fact that the paths of heat conduction seek and follow the planes of the deep vessels and highly vascularized organs situated along the dorsum of the body in close proximity to the spinal column. Furthermore, the current flow has a decided predilection for electrolytic fluids in the body cavities. As a practical example of this, we may cite the accumulation of heat even though the electrodes are not in the immediate vicinity, in a segment of the bowel or the rectum, which has been previously clamped and the fluid permitted to accumulate in its interior. This finding has an important clinical bearing on the conduct of transurethral surgery and in particular when high frequency currents are utilized as the resective agents and emphasizes the importance of preliminary cleansing of the bowel. A constipated stool, infected fissure, or ulcerating hæmorrhoid may possibly be the direct cause of heat concentration on the rectum and the subsequent development of recto-urethral and vesicorectal fistulæ. It is

significant that during the course of our study the highest temperatures were often recorded in the rectum, at times even exceeding those developed in the prostate itself.

The practical deductions reached after a résumé of the results achieved by this experimental study may be summarized briefly as follows:

1. High frequency currents generate heat in the tissues at points distantly removed from the actual site of burning, oftentimes in degree exceeding the thermal death point of the tissue cells.

2. The tissue heat generated by the cautery current never penetrates to such depths.

3. The coagulation currents producing pronounced superficial necrosis result in much less intense tissue heat than the cutting currents of higher tension values.

4. The cumulative effects of heat generated in the tissue may be partially combated by restriction of the time duration of repeated applications of the high frequency current not to retard unduly the normal blood flow through the prostate gland. We have estimated this to be 0.68 grams of blood per cubic centimeter of tissue per minute.

Broadly speaking, it is of the utmost importance that, during the performance of high frequency resections, currents of minimal tension value be employed, that the cutting action be performed expeditiously, that repeated resections at one point be avoided if possible, and that surface coagulation be utilized for the sealing of bleeding points. For these reasons extensive and repeated resections necessitating a large number of current applications are to be condemned since the accumulation of heat and subsequent tissue destruction in the outer surfaces of the gland may be productive of late sloughing and erosion with the development of urinary extravasation, fistulæ formation, etc.

It requires no stretch of the imagination to assume that the repeated applications of current and the cumulative effects of tissue heat may possibly devitalize the muscle cells of the internal vesical sphincter, thereby resulting in the incidence of urinary incontinence. It is almost a certainty that secondary hæmorrhage and urinary sepsis are the direct result of late sloughing produced by excessive tissue destruction and blood vessel erosion.

TABLE VI.—TEMPERATURES IN THE HUMAN PROSTATE PRODUCED IN A TRANSURETHRAL OPERATION EMPLOYING THE CAUTERY PUNCH

Temperature before cut—C.	Temperature after cut—C.	Time employed minutes	Notes
37.50	37.50	3	
37.59	37.59	3	Two minutes between cuts
37.83	37.83	2.5	

Four other cuts were made in this operation, but data could not be obtained.
Data below is for a different case.

Temperature before cut—C.	Temperature after cut—C.	Time employed minutes	Notes
37.62	37.62	3	Temperature in ½ min., 39.06
37.62	38.22	3	1 min., 37.98
37.87	37.87	4.5	Temperature in ½ min., 38.26
39.06	39.06	4	Maximum reached, 39.18

Obviously, in dealing with the larger type of prostatic obstructions repeat operations are to be preferred to extensive resections at a single sitting. I have been able to remove large amounts of tissue (Fig. 5) with my improved punch instrument but in doing so with the sacrifice of a certain margin of safety due to the intervention of postoperative complications. The postoperative course following extensive resections was never quite as uneventful as that associated with the less radical procedures. I therefore attribute this discrepancy to the added insult to urethral integrity and the creation of unduly large raw surfaces at the neck of the bladder without adequate provision for drainage. In dealing with the very large type of gland I believe that it is absolutely essential to permit a sufficient period of time to elapse before the obstruction is completely removed from the neck of the bladder and for that reason repeat operations should be performed. This provision is of paramount importance in dealing with a poor surgical risk who withstands instrumental trauma very poorly; but, confronted with a similar type of obstruction in a younger individual who is in all other respects

TABLE VII.—PUNCH OPERATIONS

	Number	Per cent
Total number of punches	7,415	
Operators	159	
Total hæmorrhage	588	7.9
Primary, mild	301	
Primary, severe	112	1.5
Cystotomy necessary	40	
Secondary, mild	126	
Secondary, severe	49	0.6
Cystotomy necessary	15	
Total cystotomies required in all cases in		0.7
Severe hæmorrhages, primary and secondary, in all in		2.1
Hæmorrhages in all in		27.3
Recto-urethral fistulæ	0	
Temporary incontinence	34	
Permanent incontinence	1	
Extravasation	1	
Stricture of urethra	2	
Perivesical abscess	2	
Phlebitis	1	
Rupture of bladder	1	
Peritonitis	2	
Mortality		1.09

Urinary sepsis mentioned by 22.0 per cent of the operators, and as a cause of death in 20 cases, one-fourth as many as the resections.

TABLE VIII.—RESECTIONS

	Number	Per cent
Total number of resections	8,073	
Operators	196	
Definite data as to hæmorrhage in only	7,673	
Total hæmorrhage	817	10.1
Primary, mild	272	
Primary, severe	161	2.1
Cystotomy necessary	83	
Secondary, mild	278	
Secondary, severe	106	1.3
Cystotomy necessary	36	
Total cystotomies required in all cases in		1.7
Severe hæmorrhage, primary and secondary in all, in		3.4
Percentage of all hæmorrhages		32
Recto-urethral fistulæ	5	
Temporary incontinence	113	
Permanent incontinence	33	
Extravasation	7	
Stricture of urethra	4	
Perivesical abscess	4	
Phlebitis	2	
Rupture of bladder	3	
Peritonitis	3	
Gangrene of bladder	4	
Perforation of bladder	2	
Rupture of diverticulum	1	
Ischiorectal abscess	1	
Perineal abscess	1	
Trigonal injury	3	
Pelvic abscess	1	
Torn bladder neck	1	
Periurethral abscess	1	
Electrocution	1	
Mortality (deaths 302)		3.74

Urinary sepsis mentioned by 55.0 per cent of the operators, and as a cause of death in 91 cases, four times as many as the punches.

physically sound, I prefer to perform prostatectomy in two stages.

With the assistance of Dr. John Patton, one of my colleagues, I have undertaken a statistical survey of the results achieved by transurethral surgery and in particular with regard to the incidence of postoperative complications and the comparative influence on these of the high frequency and cautery currents, respectively, in order to substantiate or disprove our experimental findings, and to determine whether or not our data were reflected in the practical experience of surgeons who were qualified in the performance of this operation. In this survey we were immeasurably assisted by the hearty co-operation of the urological profession to whom standard questionnaires were dispatched. We are deeply grateful to them for the data furnished which we have compiled and which will be presented herewith. Eight hundred questionnaires were sent to members of the profession in different sections of the country and replies were received from 244. These 244 surgeons had performed an aggregate of 15,488 transurethral operations, of which number 7,415 were done by the punch method and 8,073 by various modifications of the high frequency type of resection. There were 159 operators who employed the punch method exclusively, 196 the resection method, and 141 utilized both.

The Young punch (cold cutting), Caulk punch (cautery), and Braasch-Bumpus punch (preliminary coagulation and cold cutting) were the methods principally employed in the performance of the 7,415 punch cases; 81 operators have been using my punch instrument, 54 of whom have used it to the exclusion of all others. The cautery punch instrument was employed in 2,774 reported cases, but there are many others in which the type of punch instrument utilized was not specified. The data accumulated reveals that of the 8,073 high frequency resections, 5,560 were performed by the McCarthy instrument or one of its modifications, 855 by the Stern-Davis resectoscope method, and the remaining 1,688 by various techniques the nature of which was not specified.

With this data we have made a statistical survey with particular reference to the incidence of early and late postoperative complications and in particular (1) the occurrence of hæmorrhage both primary and secondary, (2) the necessity for cystotomy to control bleeding, (3) the incidence of grave urinary sepsis, (4) the occurrence of urinary incontinence and other disabling sequelæ. We have also made a study of the comparative influence of the cautery and high tension currents on the incidence of postoperative

TABLE IX.—SERIOUS COMPLICATIONS WHICH CAUSED DEATH ASIDE FROM ONES MENTIONED

Punch		Resection	
Total punch deaths	81	Total resection deaths	302
Sepsis	20	Sepsis	91
Embolus	1	Embolus	13
Apoplexy	2	Apoplexy	7
Cardiac	6	Cardiac	24
Shock	2	Shock	19
Septicæmia	2	Septicæmia	8
Pneumonia	13	Pneumonia	30
Uræmia	3	Uræmia	21

In comparing these two series it is noteworthy that embolus occurred almost ten times as frequently following electrical resection. Uræmia resulted over five times as commonly following resection as it did with the punch operation which unquestionably testifies to the laxity of proper preparation in many of the cases which have been operated upon by the resection method and urgently signals the strict necessity for following in the precepts of urology in the way of preliminary preparation.

complications. You will note even after superficial survey of Tables VII, VIII, and IX, that the incidence of postoperative hæmorrhage following frequency resections exceeded that following the cautery method in the ratio of 2:1 and the same proportion also applies to the necessity for cystotomy in its control. Urinary sepsis occurred as a postoperative complication more frequently with frequency resection in the ratio of 2.5:1 whereas the incidence of other complications, e.g., urinary incontinence, fistulæ, prostatic abscess, bladder rupture, greatly exceed that encountered with the cautery method, 39 times with the former and but in 9 instances with the latter. It is of interest to note that the development of recto-urethral fistula complicated the course of frequency resections 5 times (and I know of many more) whereas I have as yet to see or be advised of this eventuality following the performance of the cautery operation.

The mortality rate following the performance of transurethral surgery with the resection method by high tension currents exceeded that with the cautery method in the ratio of 3:1. Several expert electrical resectionists, who have performed a large number of operations, have reported a death rate of 17 to 25 per cent in the first hundred cases, but are now happy to relate that, after a prolonged experience, this death rate has been reduced to 5 per cent. No operation in surgery is worthy of such a human sacrifice. This serves to demonstrate the indisputable fact that the physical agent which is being employed possesses dangerous qualities, since no such hazardous effects have ever been observed following any of the punch techniques. I am aware of the fact that certain authors have reported large series of cases with a low death rate and with few postoperative complications of significance, but it is my belief that very few if any will bluntly deny a greater morbidity and mortality rate in the earlier cases of their respective series.

TABLE X.—COMPARISON OF THE COMPLICATIONS RESULTING FROM THE TWO TYPES OF ELECTRICAL HIGH FREQUENCY RESECTIONS

Gap machine	Number	Per cent
Operators	106 3,296	
Severe hæmorrhage	90	2.8
Primary, severe	52	1.5
Cystotomy necessary	24	
Secondary, severe	38	1.15
Cystotomy necessary	9	
Total cystotomies required		1.0
Rectal fistulæ	3	
Temporary incontinence	48	
Permanent incontinence	13	
Sepsis	84	2.5

Tube machine	Number	Per cent
Operators	54 1,449	
Severe hæmorrhage	97	6.7
Primary, severe	67	4.6
Cystotomy necessary	30	
Secondary, severe	30	2.0
Cystotomy necessary	15	
Total cystotomies required		3.0
Rectal fistulæ	2	
Temporary incontinence	42	
Permanent incontinence	11	
Sepsis	121	8.3

Table X reveals the astounding fact that postoperative hæmorrhage occurred three times more frequently with the tube type of high frequency generator than the gap machine and the incidence ratio of temporary and permanent urinary incontinence with this generator as compared with the gap machine was 3.5:1.

Table XI is a survey of the occurrence of hæmorrhage in the practice of urological surgeons who are equipped for the performance of both the punch and the frequency resections and this data discloses the significant fact, possibly otherwise overlooked, that primary severe hæmorrhage and the necessity for cystotomy in its control were more frequently encountered following the performance of high tension resections in comparison with the cautery punch resections in the ratio of 2:1. With the frequency type of resection secondary hæmorrhage developed during the postoperative course three times as frequently and, consequently, the mortality rate ex-

TABLE XI.—A COMPARISON OF THE RESULTS SECURED WITH THE PUNCH AND RESECTION BY 141 OPERATORS USING BOTH METHODS

Punch	Number	Per cent
Number of cases	6,008	
Primary hæmorrhage	335	5.5
Mild	251	75.0
Severe	84	25.0
Cystotomy	33 or	0.5
of total cases—10.0 per cent of primary hæmorrhages		
Secondary hæmorrhages	154	2.56
Mild	117	76.0
Severe	37	24.0
Cystotomy	13 or	0.2
of total cases—8.4 per cent of secondary hæmorrhages		
Of the total number of cases severe secondary hæmorrhage occurred in		0.6
Mortality (deaths 58)		0.9

Resection	Number	Per cent
Number of cases	4,885	
Primary hæmorrhage	292	6.0
Mild	147	50.0
Severe	145	50.0
Cystotomy	65 or	1.3
of total cases—22.0 per cent of the primary hæmorrhages		
Secondary hæmorrhages	322	6.5
Mild	237	74.0
Severe	85	26.0
Cystotomy	33 or	.7
of total cases—10.2 per cent of secondary hæmorrhages		
Of the total number of cases 1.8 per cent had severe secondary hæmorrhage		
Mortality (deaths 231)		4.7

ceeded that following a similar eventuality with the cautery method in the ratio of 5:1. This surprisingly high mortality rate following high frequency resections, the direct cause of which was hæmorrhage and sepsis in a proportion even exceeding that encountered with a similar coincidence during the postoperative course of prostatectomy, serves to impress us with the erroneous conception regarding the margin of safety associated with certain methods which are employed in transurethral surgery, to which reference has already been made.

Table XII is a detailed account of the postoperative complications encountered in 2,774 cautery resections.

I wish to add at this point that these data have not been colored by my personal observations or beliefs but are a true representative account of the material collected from various sources. The incidence of troublesome hæmorrhage was noticeable by its relative infrequency—1.6 per cent in the series of 2,774 cases of which number less than 1 per cent required cystotomy to control bleeding. The occurrence of other severe complications or disabling sequelæ during the postoperative course were negligible, 1.5 per cent of the cases

TABLE XII.—POSTOPERATIVE COMPLICATIONS OF THE CAUTERY PUNCH

	Number	Per cent
Cautery punch cases	2,774	
Total hæmorrhage	189	6.8
Primary, mild	121	
Primary, severe	36	1.3
Cystotomy necessary	10	
Secondary, mild	24	
Secondary, severe	8	0.28
Cystotomy necessary	2	
Temporary incontinence	11	
Permanent incontinence	1	
Urinary sepsis	42	1.5
Stricture of urethra	1	
Mortality		0.9

In this series postoperative complications of any consequence amounted to only 3.6 per cent.
In other words only 1.6 per cent had troublesome hæmorrhage.
Total cystotomies required in only 0.4 per cent of these cases.

developed urinary sepsis, 3.6 per cent were marred by complications of varying severity and the mortality rate was actually only 0.9 per cent.

We may summarize these findings arrived at by compilation of the data furnished by stating that the performance of transurethral resection by the cautery method in experienced hands was attended with fewer complications and a decidedly negligible mortality rate in comparison with a similar operation performed by resection methods employing the high frequency or tension current in equally competent hands, and furthermore that the latter possesses certain inherent dangers of which we must become cognizant and for which due provision must be made if we are to save this highly beneficial procedure from falling into disrepute. Certain operative methods will have to be discarded or supplemented by others which will ensure a greater margin of safety and freedom from a complicated postoperative course.

This experimental study and statistical survey testify to the enhanced applicability of the cautery method of transurethral resection in preference to the high frequency method, whether it be performed by the cautery punch method which I have advocated and of which I continue to approve as being the safest, most expeditious, and most effective method of removing obstructive tissue from the neck of the bladder, or one of the other punch techniques consisting in preliminary coagulation supplemented by the cold punch, or cold cutting with subsequent coagulation of the bleeding points.

It has been my firm conviction that visualization of the vesical orifice afforded by endoscopic light provides a more precise delineation of the prostatic rim than that permitted by the magnification of the cystoscopic lens. I have always been satisfied with this view during the performance of my cautery punch operation but complying with the insistent demand of a number of surgeons for a visual telescopic component, I have with the assistance of Dr. E. Kackley, one of my former colleagues, and the engineering skill of Mr. Drucker of Phillips-Drucker Company of St. Louis, devised an improved instrument which embodies the cautery current and telescopic visualization and which I now take great pleasure to present for your approval (Figs. 6 and 7).

The improved instrument consists essentially of the punch sheath and the cautery blade bearing at its extremity a platinoiridium blade extending ¾ of the distance around its circumference which is to be charged with cautery current generated by a step-down transformer, and in addition a McCarthy foroblique lens system and an irrigating channel providing accommodation for a fulgurating electrode. The direct forward vision provided by the cystoscopic component enables the operator not only to visualize the tissue during the act of engagement but also during the cutting process itself. The improved instrument embodies certain features lacking in the previous model, chief of which are the fact that visualization of the cutting process is enabled throughout the act and furthermore that the cutting current operates under water. The development of this feature has been a source of gratification to me since I have always felt that this proviso would enable more universal acceptance of my instrument. The simplicity of its construction with the exclusion of all unnecessary gadgets which only serve to confuse the operator expedites the performance of the operation with the utmost ease. The cystoscopic component is of such caliber that it does not interfere with the excursion of the cautery blade or with the engagement of the tissue within the slot of the sheath. Under cystoscopic vision the tissue may be grasped and retained firmly within the slot of the instrument or released at will if it has been found that insufficient tissue has been engaged for resection. With continuous flushing of the operative field the cautery blade is advanced into the sheath as far as the engaged tissue, the current applied by means of a foot switch connected with the transformer, the blade gently advanced through the tissue until it is felt to impinge on the distal end of the fenestra, at which time the current is broken, the cautery blade withdrawn from the sheath of the instrument, and the resected section of tissue extracted from the blade. The actual cutting process consumes not more than 2 or 3 seconds. The instrument may then be rotated on its long axis, another lobule of prostatic tissue engaged, and the operation repeated. The provision of a foot switch which can be operated by the surgeon has dispensed with the necessity of an assistant, and permits the operator to assume full control during the progress of the operation. The operation is performed under the guidance of the operator's eye throughout its course, and is cleanly and rapidly performed possibly more so than with the high frequency resection in which case visualization of the operative field may be obscured by gas bubbles accumulating around the resection knife. If there are any bleeding points to be sealed this procedure can be consummated with the utmost dispatch, the cautery blade being used as a deflector in order to bring the bleeding site under the direct action of the coagulation electrode, and possibly even more expeditiously by permitting the cautery blade itself to play gently to and fro over the site of bleeding. Actually we have had very little occasion to delay the operation by the intervention of troublesome bleeding. The obstructive tissue can be removed from the neck of the bladder usually within half an hour and in experienced hands possibly within 20 minutes.

The principal advantages of this modified instrument are the fact that it enables the performance of the cautery punch operation under water with the provision of complete and accurate visualization of the cutting process during the entire course of the operation.

THE PATHOGENESIS OF HYDRONEPHROSIS[1]

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An experimental study of hydronephrosis discloses several peculiarities of renal hydromechanics which have a practical bearing, not only in answer to the question of the mechanism of the production of hydronephrosis, but also in explanation of the cause of many other renal disturbances.

Hydronephrosis follows obstruction to the free flow of urine from the kidney. The common type of obstruction met in practice is partial and the pathological changes brought about by partial obstructions are not so strikingly dissimilar to the changes which sometimes follow partial obstruction of the excretory ducts of other glands. Complete obstruction of a ureter, however, produces a condition which is unique. Complete obstruction of the excretory ducts of other glands (salivary, pancreatic, biliary, etc.) leads to primary atrophy and necrosis. Primary atrophy of the kidney rarely follows complete obstruction of the ureter. This fact distinguishes hydronephrosis. The progressive hydronephrotic atrophy with complete block of the ureter has no analogy.

The pathological changes of the kidney in relation to the type of obstruction may be classified as primary and secondary (Table I). The primary change following an obstruction is either a progressive hydronephrotic atrophy, which presupposes continuation of renal activity in spite of the obstruction, or a primary atrophy which occurs only with cessation of function and a permanent anuria. The secondary changes, which may be induced by intercurrent infection, secondary anuria, or the relief of obstructions, follow an initial hydronephrotic atrophy and they give the various pictures of secondarily contracted kidneys, of the changes of infection, or of attempts at repair.

Hydronephrosis with complete obstruction of the ureter is the distinguishing feature and this type of obstruction can be controlled with ease. Therefore all experiments in the following presentation refer to complete ureteral ligation unless otherwise specified. The experimental findings which relate particularly to the pathogenesis of hydronephrosis may be summarized under the five headings which follow:

I. The pathological changes produced by ureteral obstruction.

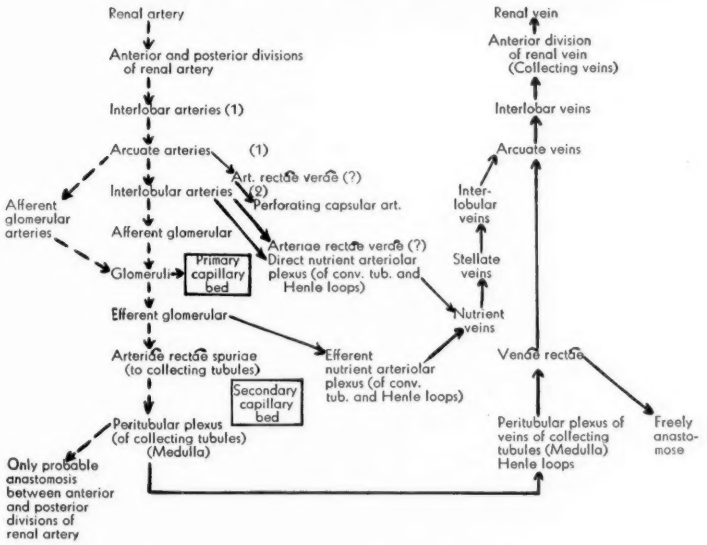
II. The effect of prolonged modification of secretory pressure upon the rate of production of these changes.

TABLE I.—PATHOLOGICAL CHANGE CLASSIFIED IN RELATION TO THE TYPE OF OBSTRUCTION

Progressive and regressive pathological changes		Secondary
Type of ureteral obstruction	Primary	
Complete (Secretion continues) (Secretion stops)	Hydronephrosis Atrophy (necrosis)	(Secretion stops) atrophy. (Necrosis) contracted kidney. (Secretion returns) hydronephrosis. Changes of infection: Pyelonephritis / Pyonephrosis — acute, chronic, suppurative, atrophic
Partial	Progressive hydronephrotic atrophy	Atrophy (contraction) Changes of infection.
Progressive (Partial to complete)	Hydronephrotic atrophy	Atrophy (contraction) Changes of infection.
Temporary (Relief of obstruction)		Hydronephrotic repair Progressive atrophy without hydronephrosis Changes of infection.
Intermittent	Periodic hydronephrotic atrophy alternating with hydronephrotic repair	Progressive hydronephrotic atrophy Necrosis without hydronephrosis Changes of infection

[1] Presented before the Clinical Congress of the American College of Surgeons, as part of the Symposium on Urological Surgery, Chicago, October 13, 1933

TABLE II.—THE RENAL VASCULATURE


Renal artery
Anterior and posterior divisions of renal artery
Interlobar arteries (1)
Arcuate arteries (1)
Art. rectae verae (?) (2)
Perforating capsular art.
Interlobular arteries
Afferent glomerular arteries
Afferent glomerular
Glomeruli
Primary capillary bed
Arteriae rectae verae (?)
Direct nutrient arteriolar plexus (of conv. tub. and Henle loops)
Efferent glomerular
Arteriae rectae spuriae (to collecting tubules)
Secondary capillary bed
Efferent nutrient arteriolar plexus (of conv. tub. and Henle loops)
Peritubular plexus (of collecting tubules) (Medulla)
Only probable anastomosis between anterior and posterior divisions of renal artery
Renal vein
Anterior division of renal vein (Collecting veins)
Interlobar veins
Arcuate veins
Inter-lobular veins
Stellate veins
Nutrient veins
Venae rectae
Peritubular plexus of veins of collecting tubules (Medulla) Henle loops
Freely anasto-mose

III. The effect of relief of obstruction upon these changes.

IV. The relation of structure to these changes, as exemplified by the comparative variations in living forms of life.

V. The relation of renal hydromechanics to the production of hydronephrosis and primary atrophy.

I. The pathological changes produced by complete ureteral obstruction in the rabbit may be divided into (1) gross changes, (2) tubular changes, (3) vascular changes.

1. *Gross changes.* The only exception to the production of hydronephrosis after complete ligation of a ureter in the rabbit is when the result is complicated by severe infection. In many hundreds of experiments a grade of hydronephrotic atrophy proportional to the period of obstruction has been the rule. Rarely has a type of secondary atrophy been found and invariably this has been associated with infection.

The kidney of the rabbit is unipapillary (Fig. 1) and the pelvis has multiple eccentric fornices formed by reflection of the pelvic mucosa about the larger arteries and veins which radiate on the outside of the single papilla into the parenchyma (Fig. 2). This arrangement gives the pyelogram with grooved arches characteristic of the unipapillary kidneys of Carnivora (Figs. 3 and 4). The first effect of pelvic distention is to dilate and widen these fornices (Fig. 5). The pelvis as a whole dilates and the single papilla shrinks, is flattened out, and finally disappears. The rim of renal parenchyma becomes thinner and thinner and after hydronephrotic atrophy has become complete, that is in about 120 days, a mere transparent sac wall of connective tissue is left. This may remain stationary in size for a time and then it may gradually shrink (Fig. 6).

2. *Tubular changes.* The structural unit of the rabbit's kidney is complex, as in all mammalian metanephroi, and it is doubtful that any conceivable unit of structure functions as a unit. Traut presupposes tubular subdivisions from the eighth generation as the structural unit (Fig. 7), but this tubular unit of structure gets a blood supply from so many different sources that it cannot be regarded as a functional unit (Fig. 8). A single tubule with glomerulus is in like position. The circulation to glomerulus, convoluted portion, and medullary looped portion is rarely integrated. The efferent vessel of the glomerulus may break up

as a capillary bed about the convoluted portion of an entirely different tubule from its own, perhaps about the convoluted portion of an adjacent and different structural unit (Fig. 9), or may form vasa recta along the looped portions of tubules other than its own (Fig. 10). This dispersion of efferent vessels and the free anastomosis in the secondary capillary bed formed thereby, destroy the possibility of any conceivable unit of structure being isolated as a functional unit but furnish the explanation of the constant unitary action of renal activity under all circumstances (Table II).

The effect of back-pressure on these excreto-secretory units will vary with anatomical position in relation to the distention of the collecting system of ducts and to the compression of the vascular tree. Injury is not diffuse and uniform. Some groups of tubules resist changes from back-pressure for long periods and even may undergo hypertrophy in compensation for the loss of other groups less favorably located. The early change is a generalized venous congestion. This and pelvic distention lead to an inflammatory reaction of the pelvic mucosa. A more or less generalized dilatation of the tubular system (Fig. 11) occurs early and in some areas this dilatation extends up to Bowman's space. It soon is followed by tubular collapse and atrophy (Fig. 12). The convoluted portions disappear first, then the looped portions disappear and the glomeruli resist longest. These changes at first show a group distribution (Fig. 13) but, in the end, all tubular elements have disappeared and only glomeruli remain (Fig. 14). Even these finally disappear, leaving a sac wall of connective tissue.

3. *The vascular changes.* All the blood to the kidney, with insignificant exceptions, passes by direct terminal branches to the glomeruli (Fig. 15) and all the blood to tubular portions is distributed by the efferent vessels of these glomeruli. Direct nutrients are not essential and what few exist are mostly anomalous. The blood is collected from the widely distributed, freely anastomosing capillary bed into venous radicles which unite to form branches corresponding in general with the arterial tree. The accompanying arteriole and venule, while near their respective capillary systems, run in a radial direction, those in the cortex are called the interlobular vessels and those in the medulla, the arteriolæ and venulæ rectæ, but the larger artery and its vein, known as the interlobar and arcuate, run in a direction more or less circumferential to the pelvic axis (Fig. 16). Pelvic distention will foreshorten and plicate the radial vessels and will lengthen and stretch the circumferential vessels (Fig. 17). The effect is to shut off the blood supply to those portions farthest from the main branch. Those groups of tubules in relation to glomeruli supplied directly by larger vessels, which thus provide circulation in the secondary capillary bed, persist the longest (Fig. 18), but pelvic distention ultimately will compress even these venous capillaries and anæmic atrophy of all tubular elements will result. Glomeruli which are on direct terminals may resist long after all tubular portions have atrophied (Fig. 19).

Summary. The pathologic changes of hydronephrosis in the metanephros of the rabbit are characterized by progressive ureteropelvic distention and parenchymal atrophy. The tubules undergo dilatation, collapse and atrophy. Glomeruli persist longest. The changes show a group distribution and are not diffuse and uniform. This early atrophy of certain groups and the relative preservation of others is related to blood supply. Both pelvic and tubular distention affect the renal circulation. Back-pressure is the primary and essential factor but anæmic atrophy is the more active and controlling factor in producing the changes of hydronephrotic atrophy.

II. The effect of prolonged modification of secretory pressure (intrapelvic pressure) upon the rate of production of hydronephrotic atrophy will be discussed under (1) the effect of polyuria and of oliguria, (2) the effect of lowering pressure by partial constriction of the renal artery, (3) the effect of raising pressure by partial constriction of the renal vein.

It is reasonable to suppose that any increase in intrapelvic back-pressure would hasten and that any decrease would slow the ordinary rate of progress of hydronephrotic atrophy, but it is not possible to show this experimentally.

Fig. 1. Photograph of the single papilla of the kidney of a rabbit. The collecting ducts of the whole kidney empty upon the tip of this papilla. The blood vessels enter the kidney at the border of the hilus and the folds of the pelvic mucosa about them give the peculiar gutter formation, as shown in subsequent figures.

1. *The effect of polyuria and of oliguria.* Prolonged polyuria can be produced either by daily intraperitoneal injections of large amounts of water, by forcing fluids in this way combined with such common diuretics as sodium chloride, urea, diuretin, and infusion of digitalis, or by performing unilateral splanchnicotomy which produces a unilateral diuresis and an increase in secretory pressure. None of these methods was found to hasten in the least the uniform development of hydronephrosis (Fig. 20). The opposite experiment of prolonged persistent oliguria produced by the constant limitation of fluid intake was found likewise to affect in no way the ordinary progress of hydronephrotic atrophy.

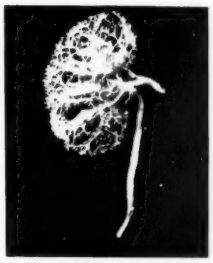


Fig. 2. Photograph of an injected specimen of the rabbit's kidney. The pelvis and renal artery have been injected and the tissues digested with hydrochloric acid. The resulting cast shows the blood vessels tunneling the trough, the formation of which is shown in previous figure.

2. *The effect of lowering pressure by partial constriction of the renal artery.* Partial constriction of the renal artery reduces the flow of blood and diminishes intrarenal pressure, thereby reducing the degree of back-pressure when the ureter is ligated. Nevertheless

Fig. 3. A pyelogram characteristic of a unipapillary kidney.

Fig. 4. A collodion cast of the unipapillary kidney of an adult dog.

Fig. 5. The effect on the pelvic fornices of 7 days' complete ureteral obstruction. The effect of compression on the venous outflow by pelvic distention is apparent. Compare with the normal, as shown in Figure 1.

hydronephrosis develops more rapidly (Fig. 21).

3. *The effect of raising pressure by partial constriction of the renal vein.* Partial constriction of the renal vein also reduces the flow of blood but increases intrarenal pressure. With partial constriction of the vein and ureteral ligation, hydronephrosis develops more rapidly up to about 20 days, at which time a collateral route for the venous outflow is established in the perirenal veins, and from this period the ordinary rate of development is followed, as after simple ureteral ligations. When the perirenal veins are ligated at the same time that the renal vein is constricted, so that a collateral circulation cannot be established to compensate for the constriction, the rate of development of hydronephrotic atrophy is accelerated (Fig. 22) up to 28 days, after which there is rapid shrinkage in size. This secondary atrophy is largely anæmic. It is more diffuse and less circumscribed than that which follows simple ureteral ligation and, as a consequence of the relative anuria and lack of pelvic distention, there is shrinkage in size and not progressive distention.

Summary. The experimental modification of the intrapelvic pressure by means of prolonged polyuria or oliguria has little effect on

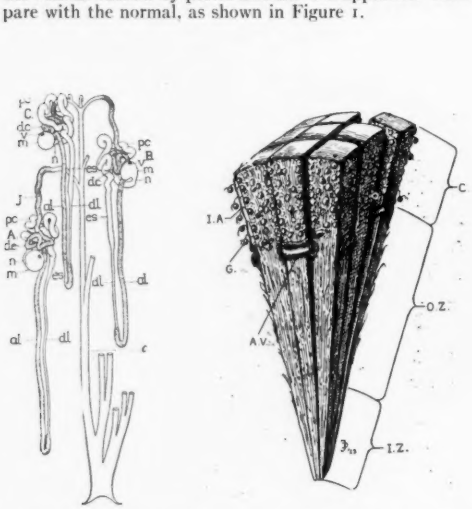


Fig. 7. Diagrammatic representation of the structural unit of the human kidney, according to Traut. The diagram at the left shows a single tubule (after Huber) which is regarded by others as a functional unit.

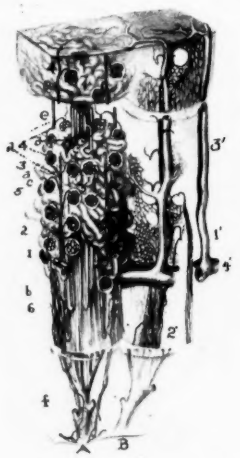


Fig. 8. Diagram showing the cylindrical unit of structure with glomeruli grouped at the periphery and tubular portions inside. It is seen that the blood supply will come from many different sources.

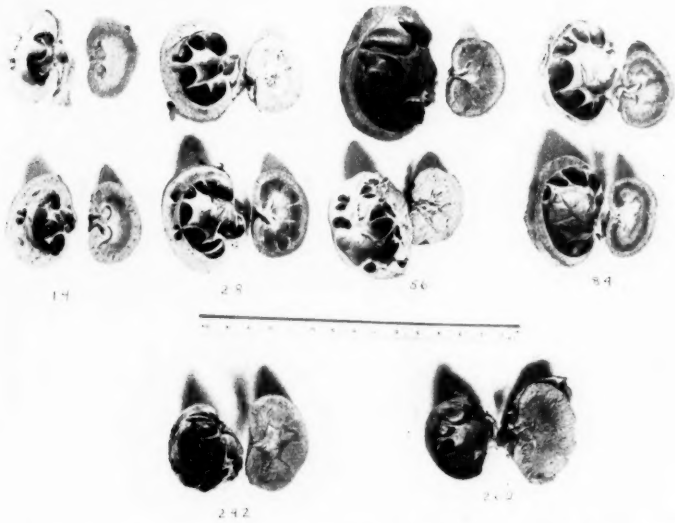


Fig. 6. A series of rabbits' kidneys showing the gross pathological changes with complete ureteral obstruction at the left and the unobstructed compensatory kidney at the right. The 14, 28, 56, and 84 day obstructions are in duplicates. The shrinkage in size after 56 days' obstruction is quite obvious.

the changes which follow ureteral obstruction, but the slightest increase in the degree of renal anæmia, by partial constriction of artery or vein, has a marked effect. When back-pressure is maintained, even at a lower level, the effect of an increased anæmia is evidenced by

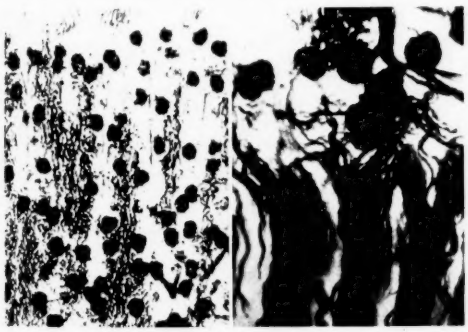


Fig. 9, left. Photograph, after venous injection, showing the rich bed of anastomosing capillaries which arise from the efferent vessels of glomeruli and supply the convoluted portions of tubules.

Fig. 10. Photograph, after injection, showing the secondary capillary bed of arteriolæ rectæ which arise from efferent branches of glomeruli and supply the looped portions of tubules and collecting system of ducts.

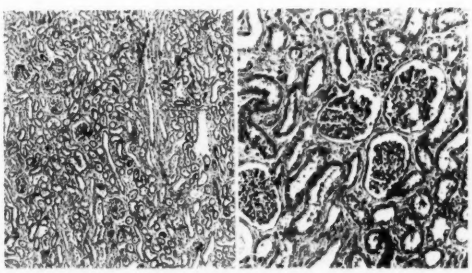


Fig. 11. Photomicrographs, low power at left, high power at right, showing generalized dilatation of the tubular system after 2 weeks' complete obstruction of the ureter.

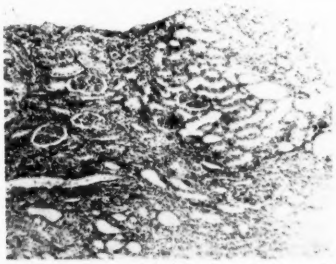


Fig. 12. Photograph showing the tubular collapse and atrophy at the left and the relative group preservation of dilated tubules at the right.

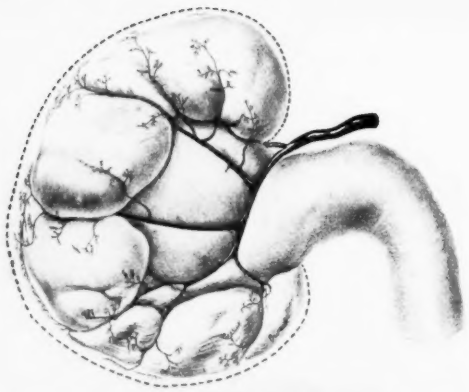


Fig. 13. Drawing of an injected specimen at a period of about 84 days' complete ureteral obstruction which explains the circumscribed character of the pelvic changes of hydronephrotic atrophy.

increased dilatation; but when back-pressure fails, secondary atrophy with shrinkage is the result. It is possible to maintain back-pressure only by a continuation of the activity of the renal parenchyma in spite of ureteral obstruction.

III. The effect of the removal of ureteral obstruction upon hydronephrotic atrophy. The distribution in groups of the pathological changes of hydronephrosis gives a reasonable expectation that the less injured groups of glomerulotubular units might recover considerable functional ability after removal of the obstruction. The experiment to test this is simple. Doubly ligate and divide a ureter as near the bladder as possible so that when the time comes to remove the obstruction, in order to study repair, the end, after it has been freed of its ligature, can be implanted in the bladder. It is found (a) that the animal (rabbit, cat, dog) cannot survive a complete ureteral obstruction of longer than 2 to 3 weeks if the opposite kidney is removed at the time of the implantation; (b) that a hydronephrosis of 3 to 4 weeks' duration may repair sufficiently to carry on total function, with survival of the animal, if there is a delay of a few months between this implantation and removal of the opposite kidney; (c) that a hydronephrosis of 30 to 40 days' duration may undergo sufficient repair to perform the needs of excretion efficiently if the burden is shifted gradually after ureteral implantation by a slow destruction of the compensatory kidney caused by partial obstruction of its ureter (Table III).

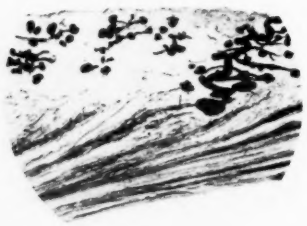


Fig. 14. Photograph of a Berlin blue injection showing the few groups of resistant glomeruli about the larger terminal branches of the renal artery.

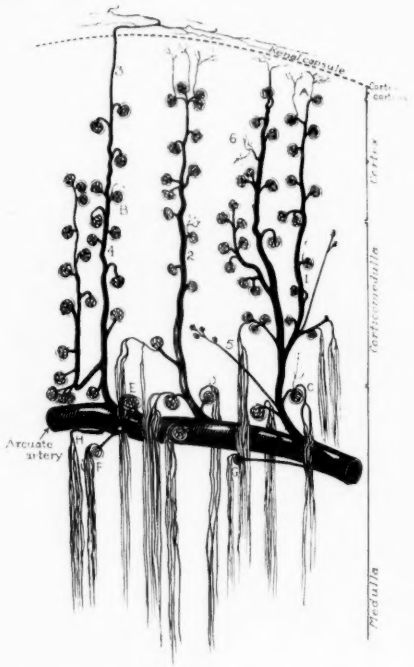


Fig. 15. Drawing which illustrates the terminal character of the arterial blood supply of the kidney. (After Morison.)

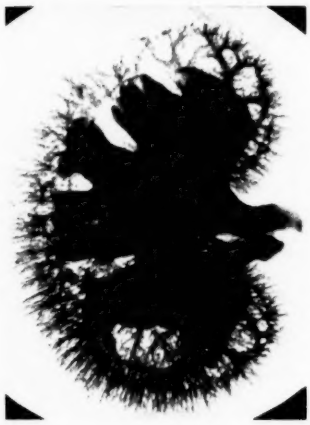


Fig. 16. Venous system of the kidney of a sheep which has been injected by way of the ureter, showing the radial course of the interlobular vessels and the circumferential direction of the larger arcuate branches.

It is found also that functional compensation of the opposite kidney occurs much more quickly than anatomical compensation, which is not complete for from 30 to 40 days. However, when an anatomical compensatory hypertrophy has occurred in the opposite kidney, the changes of repair on the hydronephrotic side (necessarily a hydronephrosis of more than 30 to 40 days' obstruction of the ureter) are reduced to a minimum and whatever repair is manifested may in time disappear. A hydronephrosis of 60 to 90 days' duration will show repair-nodules after the removal of the obstruction, but these are functionally inefficient and will disappear unless given some unusual stimulation such as would follow a severe injury to the compensatory mate.

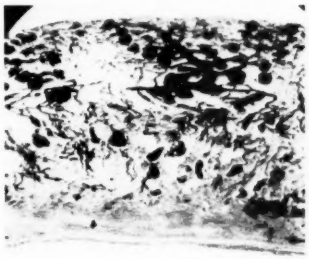


Fig. 18. Groups of persistent glomeruli in late stages of hydronephrotic atrophy.

Summary. Repair of hydronephrotic atrophy following removal of the obstruction of the ureter is characterized in the gross by shrinkage in size through loss of dilatation, and microscopically by the return of the less injured groups of glomerulotubular units to a

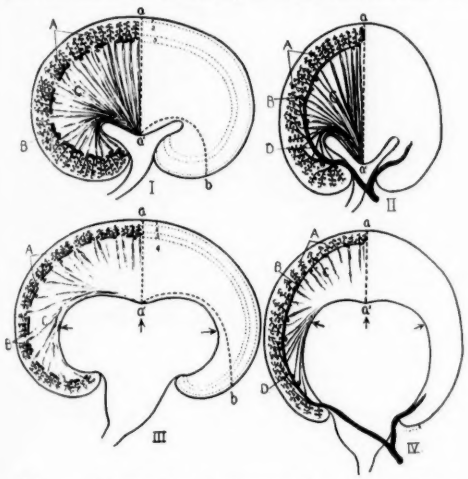


Fig. 17. Diagrammatic representation of the effect of pelvic distention showing how the vessels running in a radial direction are foreshortened and those running more circumferentially are stretched. (After Morison.)

Fig. 19. Glomeruli with straight collecting duct and complete atrophy of the intermediate tubular portion normally present, obtained by maceration and needle dissection under the binocular microscope. (After Johnson.)

Fig. 20. Photograph of the hydronephrotic kidneys, obtained by a series of experiments on rats, showing the uniform rate of development of hydronephrotic atrophy with various forms of polyuria and oliguria.

more normal appearance. The glomerular and convoluted portions of these repaired groups will show hypertrophic changes. Restoration of function will be proportional not only to the number of structural units in which repair takes place but also to the degree of hypertrophy of each. With repair, the same stage of hydronephrotic destruction will show, in different kidneys, a variation in the degree of these hypertrophic changes according to the nature of the excretory burden placed on the kidney at the time the obstruction of the ureter is removed. The maximum repair of structure and restoration of function will follow a gradual shifting of the burden such as will follow the slow destruction of the opposite kidney.

TABLE III.—VARIATION OF THE TIME OF SURVIVAL ACCORDING TO THE TYPE OF EXPERIMENT

Type of experiment	Opposite nephredomy	Dogs survive with a complete obstruction
I	At the time of hydro-ureterocystoneostomy	Of less than 2 to 3 weeks
II	One month later	Up to 3 to 4 weeks
III	One year later	Of less than 2 to 3 weeks
IV	Gradual autonephrectomy by partial obstruction of the opposite ureter at the time of hydroureterocystoneostomy	Up to 4 to 6 weeks

IV. The relation of comparative variations in renal structure to hydronephrotic atrophy. Almost all the animals used in studying hydronephrosis have been mammals, in which the kidneys are metanephroi. All have a ureter formed from a bud of the primary excretory duct which grows into the nephrogenic mother substance from which are formed, simultaneously, the glomeruli and tubules. Various types of renal pelves are developed in accord-

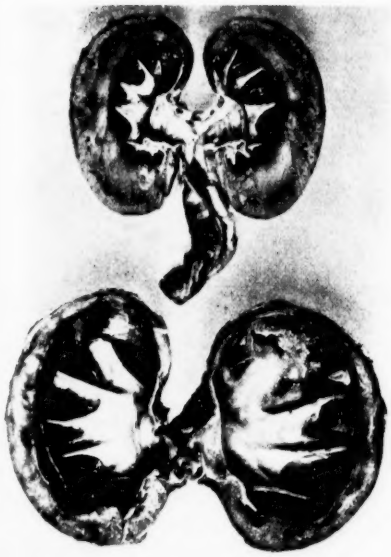


Fig. 21. The upper photograph is of a two weeks' hydronephrosis with simple obstruction of the ureter and the lower, of the same period of ureteral obstruction but with partial constriction of the renal artery.

ance with the manner of the terminal subdivision of this ureter and the degree of amalgamation of certain branches in association with the formation of the columns of Bertin (Fig. 23).

The simplest form is unipapillary (Fig. 24), which is found in all the commonly used laboratory animals (mouse, rat, guinea pig, rabbit, cat, dog, sheep). The seal shows multiple subdivisions without columns of Bertin (Fig. 25) and the whale a remarkable conglomera-

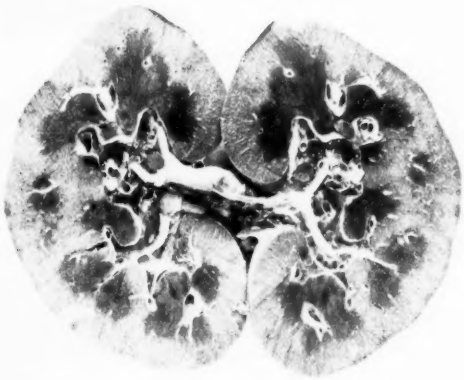


Fig. 23. Photograph of a human kidney after barium injection, showing the relation of the primary and secondary columns of Bertin to the papillæ.

tion of separate and distinct unipapillary units (Fig. 26). The bear and horse show beginning formation of the columns of Bertin and, as a consequence, a multipapillary drainage system (Fig. 27). This is well marked in the more complex pelvis with multiple calyces and well marked columns of Bertin such as that of the pig, the cow, and man (Fig. 28). In all of these kidneys, blood vessels enter and leave by a hilus and are in intimate relationship to the pelvis, irrespective of type, which occupies the hilus as a renal reservoir (Fig. 29). The fornices of each pelvis are formed by the mucosal reflection and folding about the entering vessels, and pelvic distention is an important factor in producing venous stasis as well as circumscribed anæmia. Complete obstruction of the ureter of all the mammals so far studied produces the pathological changes of hy-

Fig. 22. The photograph at the left is control of 2 weeks' ureteral obstruction, the upper at the right shows an acceleration in the rate of hydronephrotic atrophy for the same period with partial constriction of the renal vein, and the lower, a still greater acceleration when the collateral circulation is also tied off at the time the ureter is obstructed and the vein is partially constricted.

Fig. 24. Unipapillary type of kidney, specimen at left unobstructed; at right, after 7 days' ureteral obstruction.

dronephrotic atrophy similar to those in the rabbit, except for variation in the time of completion which is closely proportional to the size of the kidney (Fig. 30).

A natural question is: Do the pathological changes of hydronephrotic atrophy develop only in kidneys with this structural arrangement? All other kidneys are apelvic and blood vessels enter, for the most part, on the side opposite the excretory duct. There is neither a hilus nor a pelvis. The kidneys of living Vertebrata lower in the scale of life than Mammalia may be grouped as:

I. The apelvic metanephroi,
   1, Of Reptilia,
   2, Of Aves.
II. The mesonephroi (all apelvic),
   1, Of Amphibia,
   2, Of Pisces.

Fig. 25. The pelvis of a seal. a, The gross appearance with marked lobulation. a′, Pyelogram showing the pronounced branching. b, Embryological stage of development of the human kidney at a period which corresponds to the permanent arrangement reached in the seal.

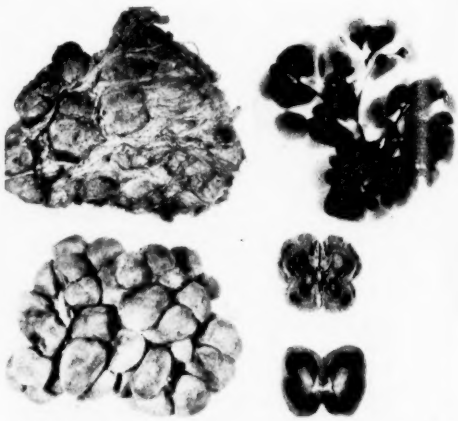


Fig. 26. The conglomerate unipapillary kidneys of the whale. The two photographs at the left show the gross appearance of the unipapillary units of a small portion; at the right, are the unipapillary pyelograms after injection of the common ureter; and below, are shown single units, the upper of which is hydronephrotic. (After Belt and Charnock.)

III. The functioning pronephros of some amphibian larvæ (Amblystoma).

The emunctories of invertebrates are nephridia. No studies have been made on the effect of obstruction of the duct of any of these excretory organs. The pathological changes produced could be similar in no sense to those seen in the metanephroi of mammals. But the metanephroi of reptiles and birds, the mesonephroi of amphibians and fishes, and larval pronephroi are homologous organs, direct evolutionary stages from the same mother substance. A study of the effect of obstruction of the duct on these homologous organs gives

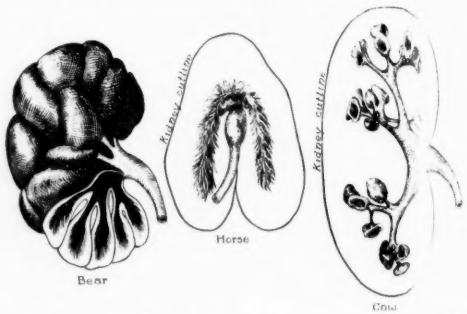


Fig. 27. Diagrammatic representation of the pelvic arrangement in the bear, horse, and cow.

Fig. 28. Collodion cast of the pelvis of the kidney of a cow, showing the relation to its arterial tree which had been injected simultaneously.

interesting information as regards the relation of structure to the changes which characterize hydronephrotic atrophy.

The distinguishing characteristics of these three stages of nephric development may be summarized briefly.

In a pronephros, the tubules develop in advance of the pronephric duct. Glomeruli are cœlomic in origin, unattached to the tubule and are called external glomeruli. The tubule opens off the cœlomic cavity by a nephrostome in a manner exactly like the nephridia with nephridiostomes found in many invertebrates (Fig. 31). The glomerulus, however, is

Fig. 29. The arterial and pelvic casts of the human kidney. The posterior branch of the renal artery is detached.

a new departure and is unknown in invertebrate forms of life.

In a mesonephros the pronephric duct becomes the primary excretory duct into which open the mesonephric tubules. These tubules develop after the duct has formed, acquire an internal glomerulus and lack the nephrostomal opening into the cœlom. Each meso-

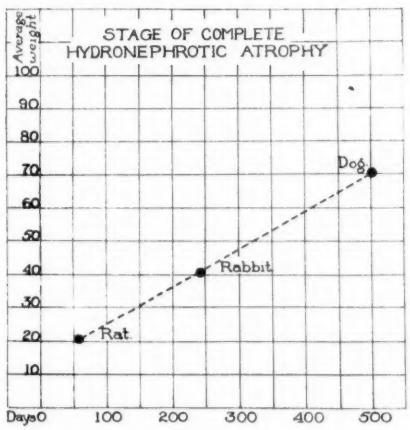


Fig. 30. Showing the different periods at which complete hydronephrotic atrophy occurs, according to the size of the kidney.

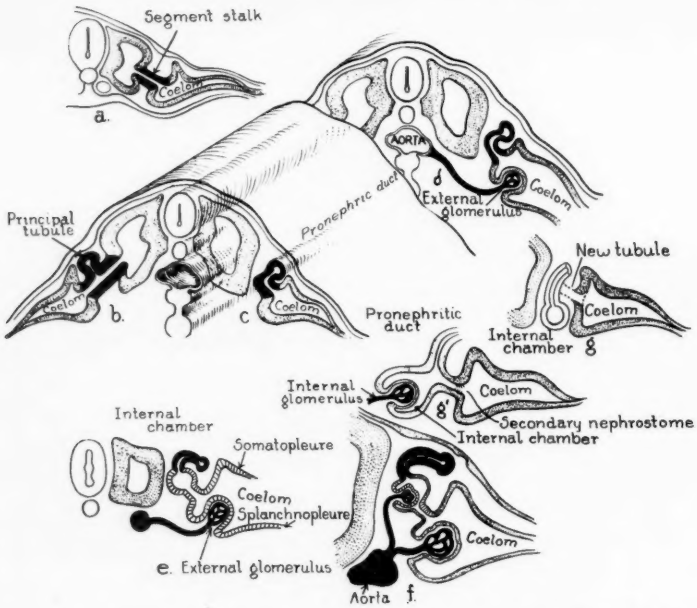


Fig. 31. Drawing which illustrates the development of the pronephric duct and tubules from the segmental stalk and which illustrates the difference between external and internal glomeruli.

nephric tubule becomes a closed glomerulotubular unit (Fig. 32).

In a metanephros, the ureter is formed from a bud of the primary excretory duct which becomes the seminal duct in the male and the vestigial Gaertner's canal in the female, and grows by dichotomous branching into the nephrogenic mother substance where communication is established with the glomerulotubules which have formed independently (Fig. 33).

At a certain period of development in some animals all these three stages can be demonstrated side by side, but in all adult forms of life a permanent stage is reached.

The pronephros is the permanent stage of no known living animal but it forms the functioning kidney during part of the larval period of many fish and most amphibians. Ruth Howland has shown that resection (and obstruction) of a segment of the pronephric duct of such a functioning pronephros in a larval Amblystoma caused compensatory hypertrophy of the opposite pronephric tubules and a bilateral speeding up of mesonephric development without similarly affecting the external glomerulus of the two sides or producing dilatation of the nephrostomal tubules of the obstructed side. This in no way simulates the changes of hydronephrotic atrophy.

The most primitive, functioning, permanent mesonephros is found in cyclostomes and fishes. Studies of the effect of complete obstruction of the primary excretory duct of these kidneys are wanting. The effect of such obstruction on the aglomerular kidney of certain teleostomi would be instructive (Fig. 34). The blood supply of the aglomerular kidney (toadfish) is purely venous and yet a secretory pressure in excess of aortic pressure is developed. The factor of back-pressure is entirely adequate, yet the pathological change which awaits experimental demonstration probably will simulate primary atrophy, and bear no resemblance to hydronephrotic atrophy. The kidney with lymphatic stroma of the catfish, however, has fairly well developed glomeruli and a few experiments with bilateral ligation

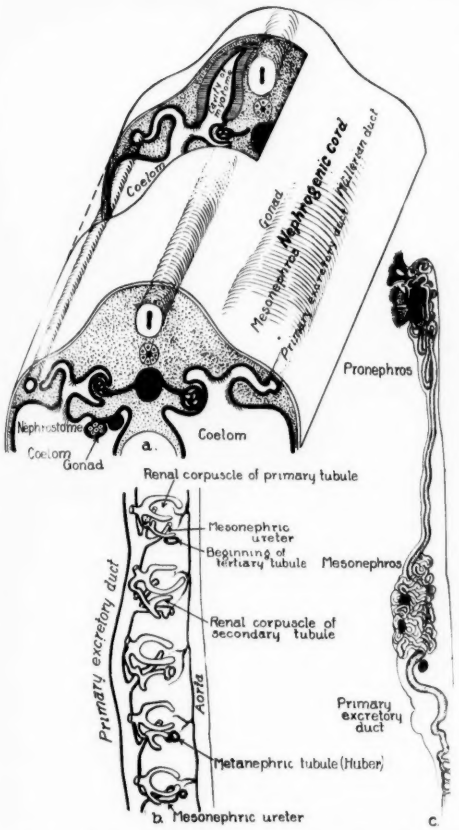


Fig. 32. A drawing which illustrates the homology of pronephric and mesonephric tubules. a, Tubular development from the segmental stalk in relation to the primary excretory duct. b, The relation of these tubules to the collecting duct. c, The primitive kidney with both pronephric and mesonephric tubules.

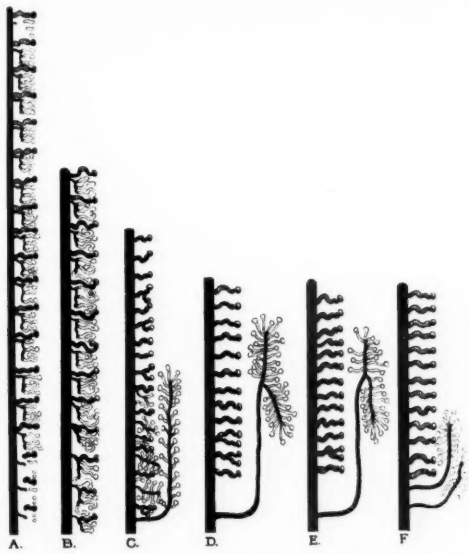


Fig. 33. Diagrammatic representation of the distinction between mesonephros and metanephros. A, An embryonic stage of an amphibian. B, The permanent stage of A. C, The meso-metanephric combination of some birds. D, the embryologic stage in the rabbit. E and F, The two embryological types in man. (After Felix.)

(the ducts unite before entering the bladder and could not be tied separately) (Fig. 35) have demonstrated tubular dilatation, but the time period before death in uræmia (about 20 days) was always too short to establish fully the pathological picture.

In frogs and salamanders (Amphibia) (Fig. 36), in alligators, snakes and turtles (Reptilia), and in chickens and pigeons (Aves) (Fig. 37), obstruction of the primary excretory duct, or the ureter, as the case may be, produces almost uniformly the progressive pathological changes of marked dilatation of the larger collecting systems: dilatation, collapse and atrophy of unitary tubules, a relatively long persistence of glomeruli, and a microscopic picture which characterizes hydronephrotic atrophy in the metanephroi of mammals. These changes, however, are more diffuse in earlier stages and not so circumscribed as in mammals and because of structural differences shrinkage rather than distention is more manifest grossly (Fig. 38).

Summary. The structural arrangement of the hilus and pelvis, as in the metanephroi of mammals, is not essential to the development of hydronephrotic atrophy. The apelvic metanephroi of Reptilia and Aves and the apelvic mesonephroi of Amphibia show similar pathological changes after obstruction of the duct. So far, hydronephrosis has been demonstrated only in nephroi with internal glomeruli.

V. The relation of renal hydromechanics to the production of hydronephrosis. The height to which the urine, or the mercury of a manometer, can be raised against gravity by the secretory activity of a mammalian

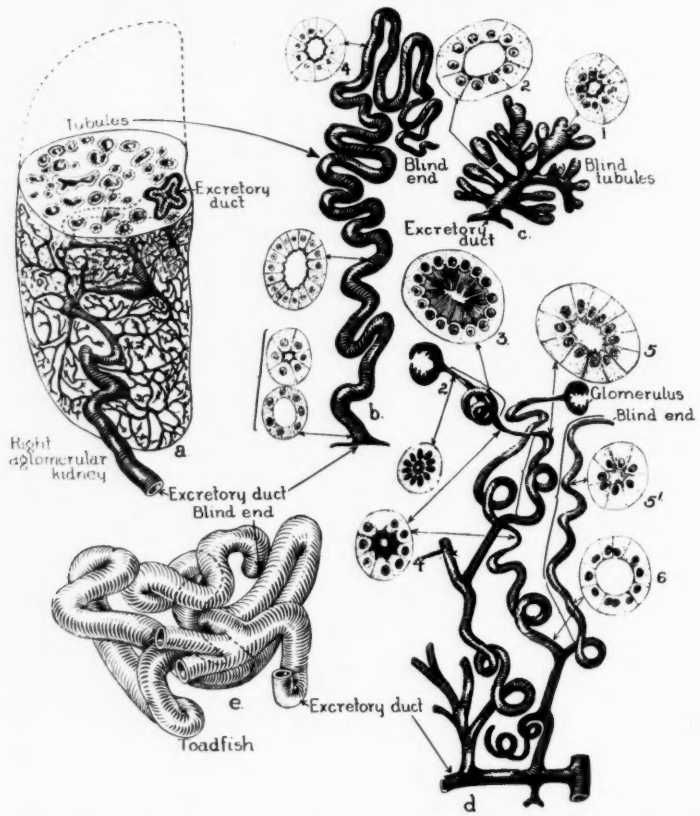


Fig. 34. Drawing of the structural arrangement of the aglomerular kidney of some Teleostomi. a, Gross arrangement. b, c, and e, Types of aglomerular tubules. d, Mixed kidney having tubules with and without glomeruli.

kidney varies with blood pressure and with the relative activity of the glomeruli at the time, but never is in excess of the afferent glomerular pressure. Other glands and the aglomerular kidney of a toadfish show secretory pressures independent of and at times in excess of blood pressure. These pressures, however, are of short duration, whereas renal secretory pressure is maintained up to the point of renal destruction, which takes several months. During the progress of these changes, the intrapelvic pressure, under continual fluctuation, shows a gradual decline. The prolonged maintenance of secretory pressure even at diminishing levels requires a continuation of renal activity which is possible only with removal of the products of activity, and when the ureter is blocked completely the only route of removal is by reabsorption. That an active reabsorption occurs is demonstrated by the fact that the content of a hydronephrotic sac at any period has the same composition as the urine first excreted by that kidney after removal of the obstruction. In a fresh water lake, there is inflow and outflow. There is no stagnation. Dye stuffs which are placed in the pelvis disappear rapidly. Phthalein is recovered in the urine of the opposite kidney within a few hours. How does this take place?

Reabsorption of threshold substance at certain levels of the renal tubules is an im-

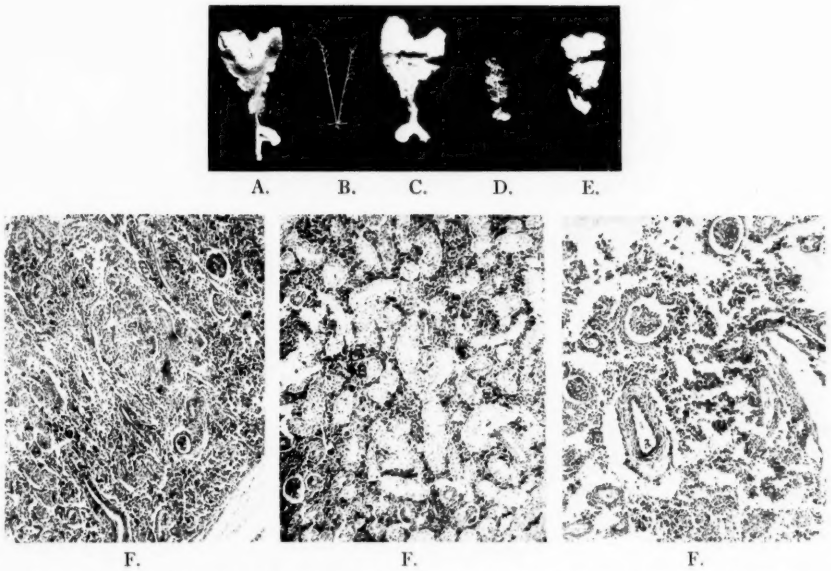


Fig. 35. Experimental hydronephrosis in the catfish. Photomicrographs show, at the left, normal appearance, the middle, 7 days', and at the right, 14 days' complete obstruction.

The gross specimens above, A, normal appearance, B, the normal primary excretory duct after collodion injection, C, appearance 7 days after complete obstruction, D, the collodion injection of a 7 days' obstruction, E, 4 weeks' bilateral obstruction with death from uræmia. (After Carroll.)

portant conception of urinary secretion according to the modern theory. This activity is highly selective and cannot explain the total reabsorption of hydronephrosis; besides, functioning tubules disappear rather early.

Several routes of mechanical back-flow can be demonstrated in normal kidneys by forceful injection of the ureters. That a pyelovenous route may occur spontaneously in a mammalian kidney with a pelvis is suggested by the finding that considerably less pressure is required to produce a back-flow in early stages (up to 14 to 20 days in the dog) than in normal kidneys (Table IV). That this cannot be the only route is demonstrated by the impossibility of producing a pyelovenous back-flow in hydronephrosis resulting from a longer obstruction (in dogs), as well as by the fact that the parenchymal changes of hydronephrotic atrophy occur in apelvic kidneys in which pyelovenous back-flow is an impossibility.

A back-flow of pelvic contents up the collecting ducts of one or more renal papillæ is observed occasionally at the time of pyelography and shows in the pyelogram as the tuft formation on a minor calyx (Fig. 39). Both pyelovenous and tubular back-flow may mar the same pyelogram. The predominance and ease of production of either will vary with species, tubular back-flow being relatively easier in the dog or the monkey, but more difficult in the rabbit or the rat. In most mammals tubular back-flow occurs more readily after a few days' ureteral obstruction. A number of observations demonstrate that this tubular fluid under pressure finds ready access to the venous system. Under a lens, an individual duct of Bellini can be catheterized with a blunt hypodermic needle and, if injected slowly and gently with some dye stuff, the corresponding venous area is seen to fill out and then to expand throughout the kidney until the whole venous system is injected and the dye drips from the renal vein. The point of communication from tubule to venule remains undetermined. Under the microscope, Richards observed a mercury droplet pass

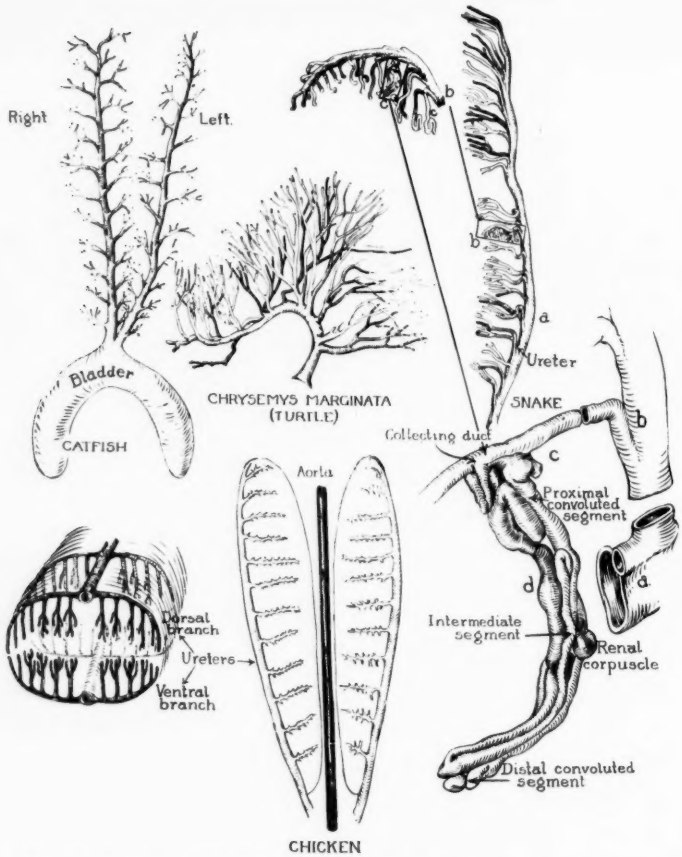


Fig. 36. Drawing which illustrates the collecting and excretory duct systems of various lower vertebrates.

directly from an obstructed tubule into a neighboring venule during one of his physiological experiments in the living frog, and Edwards saw the terminal capillaries and venules of the frog's mesonephros rapidly fill with media injected by way of the primary excretory duct. A tubulovenous route of back-flow therefore is a possibility.

Another route of mechanical back-flow is the interstitial. Injections through a needle thrust into the renal parenchyma at random readily find the venous circulation. Rupture, by back-pressure, of the pelvic mucosa or tubular epithelium need not be directly into a neighboring vein to cause back-flow. Fluids extravasating into the interstitium soon reach the vulnerable wall of a venous or lymphatic vessel.

These three routes of back-flow are useful in the explanation of the mechanism of the production of hydronephrotic atrophy. In mammalian kidneys, with pelvis and papillæ, an early pyelovenous back-flow permits continuation of secretion until the early mechanical closure of the ducts of Bellini is removed, after which the pelvic contents have ready access to the tubular lumina and a tubulovenous back-flow occurs. There is a fluctuating play of pressure in the pelvis and tubules, rising with secretion, falling with back-flow,

diminishing like the swing of a pendulum until all excreto-secretory ducts have atrophied. Should a back-flow fail to occur at the onset, urinary secretion will cease at the height of secretory pressure and the pathological picture of a primary atrophy rather than a hydronephrotic atrophy will result. An intercurrent infection or any other factor causing anuria at the onset will result in primary atrophy. In the apelvic kidneys of reptiles, birds and amphibians, the back-flow is largely tubulovenous.

An interesting experiment is a study of the relative changes produced by ureteral and papillary obstruction (Fig. 40). Ligation of the papilla of the unipapillary kidney of the rabbit obstructs the tubules directly and removes the effect of pelvic distention as well as the possibility of pyelovenous back-flow. The microscopic changes produced resemble the hydronephrotic atrophy which occurs in apelvic kidneys. The progressive changes of tubular dilatation, collapse, and atrophy are more diffuse in distribution, less marked in degree and more rapid in their rate of progress than those which follow ureteral obstruction (Fig. 41). This would be expected as there cannot

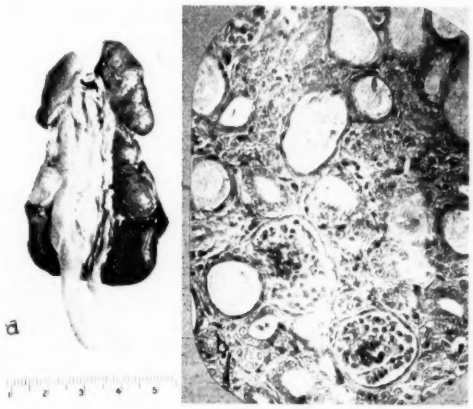
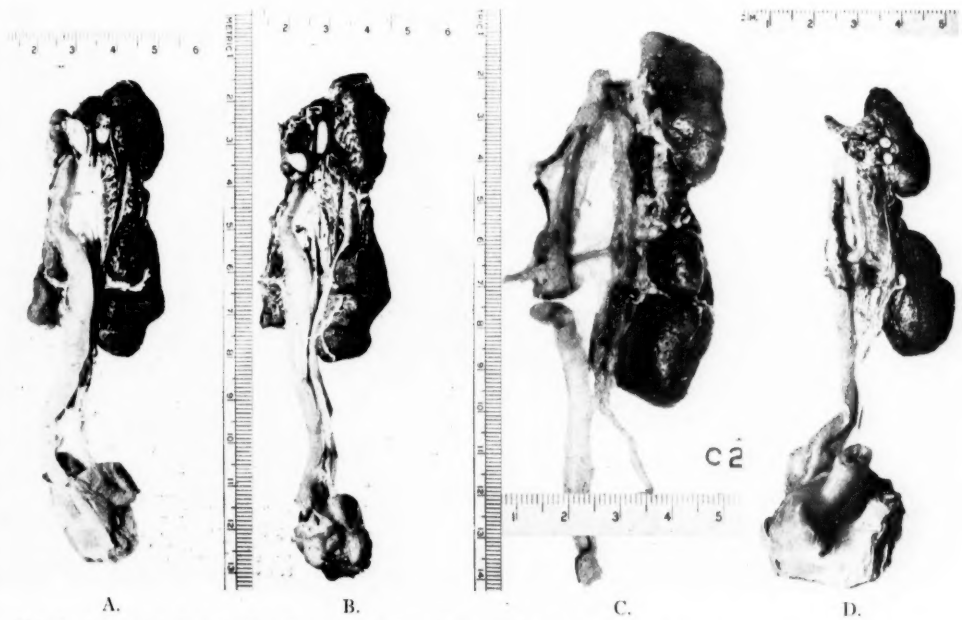


Fig. 37. The gross and microscopic appearance of the right kidney of the chicken after 7 days' complete obstruction of its ureter. The unobstructed kidney is shown at the left. The microscopic picture shows generalized tubular dilatation.



A. B. C. D.

Fig. 38. A series of photographs of gross specimens after varying periods of complete ureteral obstruction in the chicken. A, 35 days', B, 46 days', C, 2 months', and D, 6 months' obstruction.

Fig. 39. Tuft formation due to tubular back-flow at the time of pyelography.

TABLE IV.—RESULTS IN 4 EXPERIMENTS IN THE RABBIT TO SHOW THE DIMINISHING DEGREES OF BACK-PRESSURE REQUIRED TO PRODUCE BACK-FLOW PROPORTIONAL TO THE PERIOD OF OBSTRUCTION. (AFTER FUCHS.)

Rabbit	Duration of obstruction hours	Injection pressure required to produce back-flow in the obstructed kidney mm. Hg.	Injection pressure required to produce back-flow in the opposite obstructed kidney mm. Hg.
I	5	30	80
II	24	20	100
III	48	0	90
IV	72	15	90

be the same play of back-pressure and back-flow as is present with a dilating pelvis and ureter.

Complete atrophy occurs much earlier, but the differences are relative and the microscopic changes are those of hydronephrotic atrophy. This also explains the differences between complete and partial obstruction in the rate of progress and degree of distention (Fig. 42).

Summary. A theoretical consideration of hydronephrotic atrophy establishes the assumption that secretion continues even with complete obstruction and that an outlet for this urine is necessary. This assumption is confirmed by all experimental findings. The mechanism of production requires an active counterplay between back-pressure and back-flow. A rise in secretory pressure promotes a back-flow which lowers it, thus permitting further secretion. The back-flow must be of a

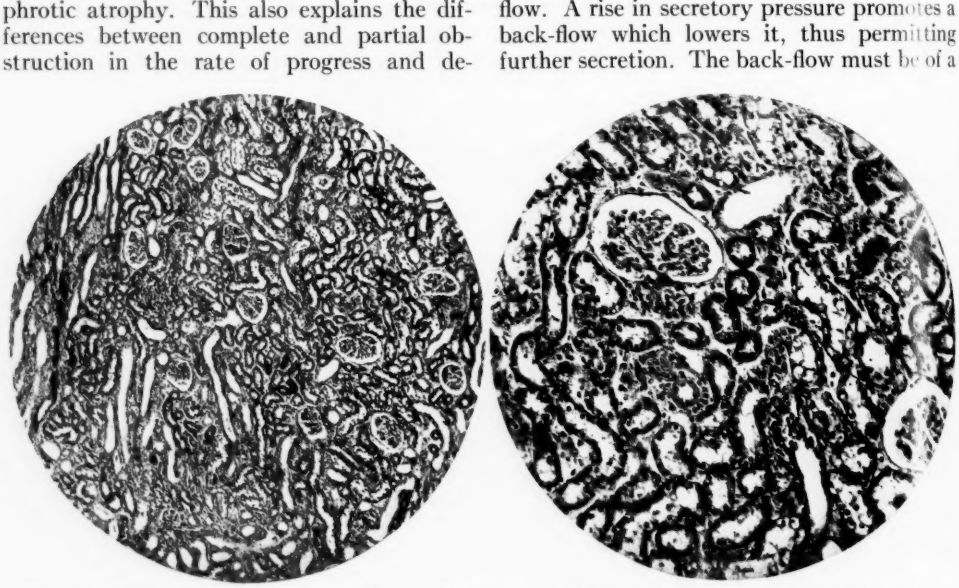


Fig. 40. Photomicrographs showing the microscopic changes 2 weeks after papillary obstruction. To be compared with Figure 11, 2 weeks of ureteral obstruction. The degree of dilatation is greater and the stage of hydronephrotic atrophy is more advanced. (After Carroll.)

Fig. 41. Gross specimens illustrating the difference between papillary and ureteral obstruction. The specimen at the left shows marked atrophy of the lower pole 4 weeks after half of the papilla on this side had been ligated. The photograph at the right is of hydronephrosis of 4 weeks. (After Carroll.)

resistant type. An easy back-flow would fail to give the in-and-out play necessary to produce the progressive dilatation and parenchymal atrophy.

The escape of pelvic and tubular contents into the venous system of the kidney offers a simple explanation of the mechanism of the production of hydronephrotic atrophy. Experimentally, tubulovenous back-flow can be produced only with difficulty in most kidneys which have pelves, but is easy of production in the same type of kidney after a certain period of hydronephrosis. In the apelvic kidneys of birds, reptiles, and amphibians, a tubulovenous back-flow is produced easily.

CONCLUSIONS

1. The pathological changes of hydronephrotic atrophy are types of the degeneration produced by pressure and anæmia and are peculiar to the kidney. Complete obstruction of the excretory ducts of other glands produces almost immediate cessation of function, and primary necrosis and atrophy. Primary renal atrophy following complete obstruction of a ureter is the exception and occurs only when there is an initial anuria.

2. Experimental modification of secretory pressure does not influence the progressive changes in a related manner. Hydronephrotic atrophy shows the same ordinary rate of development both with water starvation and with forced diuresis. Lowering and raising the pressure by partial obstruction of the renal artery and vein hasten the rate of development, not through the influence of increased intrapelvic pressure but because of the increased ischæmia.

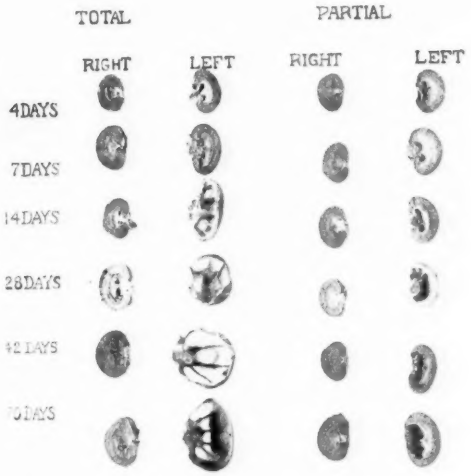


Fig. 42. Parallel series of rat kidneys showing hydronephrosis produced by total and partial obstruction of the ureter.

3. The degree of structural repair and restoration of function which will follow removal of the obstruction of the ureter will vary, not only with the extent of the injury which has been produced, which is proportional to the period of obstruction and to the freedom from infection, but also with the degree and manner of functional stimulation. A gradually increasing excretory load, such as occurs with slow destruction of the opposite kidney, will effect a more permanent and greater structural repair than will a lesser stimulation, such as occurs when the opposite kidney has undergone compensatory hypertrophy, or a too sudden overload, as in the case of removal of the opposite kidney. An efficient compensatory mate diminishes and an insufficient kidney on the opposite side increases the potentiality of repair of hydronephrosis.

4. The pathological changes of hydronephrotic atrophy have been found only in kidneys with internal glomeruli. The gross and microscopic changes occur most typically in the mammalian kidney which has a hilus and a pelvis. However, this structural ar-

rangement is not essential. Similar changes follow complete obstruction of the ureter or the primary excretory duct of the apelvic kidneys of reptiles, birds, and amphibians. The microscopic changes which follow the direct obstruction of tubules in the pelvic type of kidney, as occurs when a papilla has been tied, resemble those which follow indirect obstruction, as occurs when the ureter has been tied.

5. The mechanical factor in the development of hydronephrotic atrophy is a back-flow of urine into the venous system. In mammalian kidneys, this back-flow probably is at first pyelovenous and later tubulovenous. In the apelvic mesometanephroi of reptiles, birds, and amphibians, the back-flow is tubulovenous. Whenever a back-flow fails to occur upon complete obstruction of the excretory duct, anuria develops and the pathological change of primary atrophy instead of hydronephrotic atrophy will result.

I wish to acknowledge my indebtedness to the following men who have collaborated in much of the experimental work referred to in this paper: A. Elmer Belt, Duncan M. Morison, Robert K. Lee-Brown, Alexander B. Kepler, Thomas E. Gibson, Adolph A. Kutzmann, Oliver W. Butler, Clark M. Johnson, Donald A. Charnock, A. Howard Dart, William A. Carroll, John J. Sullivan.

THE PROSTATE GLAND—ITS PLACE IN GENERAL MEDICINE[1]

Newer Conception of Diagnosis and Treatment

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BECAUSE of the recent advent of new instrumental measures designed for the correction of obstructing prostatism, the general profession has become prostate conscious. This is a constructive state of affairs inasmuch as it may in all fairness be said that in the past, the potentiality of this organ as a causative agent in systemic disease has not been generally recognized. This gland has been chiefly regarded as a trouble breeder in early adult life, from the standpoint of infection, and, in the senile period, because of its obstructive manifestations. It seems timely, therefore, to emphasize the intervening presenile zone, as herein there exists an open field for constructive therapeutic endeavor.

It has been an interesting observation that pathological reports on prostatic tissue removed during the course of endoscopic resection has frequently revealed the presence of some form of prostatitis. Moreover, the studies of Rosenow, von Lackum, Nicoll, Stuhler, Neilson and others, have indicated the frequent occurrence of metastatic infections of this gland, and among other things, the existence of arthritis wherein the removal of teeth and tonsils was unavailing; the arthritis persisting until the prostatic focus had been eradicated. It must be obvious, therefore, that any precise knowledge of systemic infection, lowered resistance, etc., in these patients, automatically involves the same knowledge as to the pathological status of the prostate. May it truthfully be stated that the profession at large has this knowledge—it may not. To quote from a previous publication, "were the methods and practices employed by us as a profession, to be scrutinized by an unbiased and informed group of investigators, they would not perhaps place us in the same category as the ancient Egyptian physicians, in whose time there were no general practitioners. In their stead were aurists, dentists, doctors of the head, the stomach, etc., and wherein each was forbidden to invade the territory of his colleagues. The unfortunate Egyptian patient was marked off like a chessboard into little squares, and whenever the pain made a fresh move, a fresh doctor had to be called" (Winwood Reade, *Martyrdom of Man*).

The investigators mentioned, however, could, and along similar lines undoubtedly would, find many incongruities in our psychological approach to patients. They would note the omnipresent evidence of the stressing of certain sectors of the body with the most casual consideration of others.

What should this knowledge convey to us as physicians if we are as we should be—alive to factual data? Its import is that, as a profession, we have been remiss in subjecting this all important structure—the prostate—to the routine scrutiny that its too obvious possibilities for evil demand. It is a simple matter to correct this situation by including, in every general physical examination, microscopic and cultural studies of this gland, regardless of whether the patient gives an antecedent neisserian history or not. Such measures are of the utmost importance from a sociological standpoint, inasmuch as these patients are or should be at the peak of their economic and productive usefulness; furthermore it is true that 25 per cent of all male mankind is in later life destined to suffer from obstructing prostatism, and that low grade prostatitis is, in all likelihood, a matter of much more common occurrence. Inasmuch, also, as we are now passing through a highly controversial, though progressive, stage of evolution in the surgical approach to the prostate, it is important that the profession in general focus their attention on the kaleidoscopic changes that are taking place in this field. This is no time for dogmatism or complacency; an open minded, if critical, study of the various methods advocated, cannot fail to

[1]Presented before the Clinical Congress of the American College of Surgeons, Chicago, Friday, October 13, 1933.

result in benefit to all concerned. The time has come also, to consider the proper scope for the use of instrumental measures in the correction of prostatic obstruction and the relation between them and the various methods of open surgical approach. On the basis of our enhanced knowledge, the older open methods should be reinventoried to determine if they will withstand the exigencies, the exactions of the future. Adequate consideration of prostatic surgery must comprise a study of the pre-operative morbidity, hospital domicile, mortality, posthospital disability, and permanency of result.

SUPRAPUBIC PROSTATECTOMY

It has been the rule heretofore that before the patient would submit to so serious an operation as suprapubic prostatectomy, he frequently elected to undergo a more or less prolonged period of morbidity, in many instances to the point of intolerance, before submitting himself to so burdensome and, as he at least regards it, dangerous an operation. The hospital domicile of this operation may vary anywhere from 3 to 8 or more weeks. The average stay in the hospital after operation at the Post-Graduate Hospital during the past 10 years has been, for the one stage suprapubic procedure, 41.1 days, for the two stage operation, 49 days. Disability after leaving the hospital has extended from several weeks upward. The mortality rate is still too high; one may obtain from equally eminent authorities, figures varying from 5 to 20 per cent. Recently, at the Congress of Urology held in London, Sir John Thomson-Walker, its chairman, an internationally known and respected authority, stated (quoted from memory) that in their special urological services and in a very large series of cases, the mortality was approximately 9 per cent; whereas in the general services, the rate rose to 18 per cent. In this country, doubtless a similar condition exists. It should be conceded, however, that individual surgeons have from time to time reported series of cases in which the rate was considerably less than the foregoing. Since the introduction of endoscopic resection in our service at the Post-Graduate Hospital, the writer has performed but 17 suprapubic prostatectomies in which there has been 1 death—a rate of 5.5 per cent. The bright side of this picture is that in the event of success it offers, with negligible exceptions, splendid functional result and permanency. Having in mind the time and burdensome expense involved, the mortality, the prolonged hospital domicile and post-hospital disability, not to mention the nervous strain on patient and family, it is seriously to be questioned if this operation even in the restricted number of patients coming to open surgery, will continue to enjoy its vogue of the past.

Perineal approach. Because of its minimal systemic reaction, the perineal approach has been attended with a very low mortality rate. The hospital convalescence is or should be shorter, the posthospital disability less. This operation has not enjoyed general favor because of the occasional undeniable operative accident of recto-urethral fistula and post-operative urinary incontinence or urethral stricture. Nevertheless, our impression of the moment in the light of this survey and under the changed conditions of the present is that, with certain technical improvements obviating the possibility of recto-urethral fistula at operation and postoperative incontinence, this method will probably enjoy a merited renaissance in the years immediately before us.

Endoscopic resection. It is now almost 3 years since the method of endoscopic resection as advocated by the writer, was first performed in our service. In the interim, the method has been taken up by many institutions and individuals here and abroad. The efforts of some have resulted in failure. The mortality rate in the early cases of others has been disproportionate to the results in their later series. Apparently, no amount of admonition could have prevented this situation as every communication by the writer on this subject purposely carried sufficient warning to act as a curb on the overenthusiastic. On the other hand, it should be noted that in some of the largest urological clinics of this country one or another of the instrumental methods of endoscopic resection have replaced the older methods of open surgery in the preponderating number of cases. Many others are employing

it to their complete satisfaction in an increasing number of prostatics. Some have gone to the extreme of employing it in every case wherein it is possible to pass the instrument.

In our service at the New York Post-Graduate Hospital during this period, the operative mortality in benign hypertrophies has been about eight-tenths of one per cent. The age range of the patients operated was from 45 to 89 years, and included ward and private patients. The postoperative hospital domicile averaged 9.7 days, and in our later cases one week. In but a few of our early cases was a secondary resection indicated. In the past year the writer has not had occasion to perform a single secondary resection. Immediately after operation the patients have a period of increased frequency and turbid urine which clears up without local treatment, and which does not, as a rule, interfere with the performance of their customary duties. The late symptomatic status in a few cases was not at all satisfactory, probably the result of pulling our punches and failing to carry out canalization with no overhanging encroachment of prostatic lobules. Complete canalization generally gives perfect functional result.

Permanency. It would be illogical to dogmatize on this feature at this time. Permanency here depends not only on pathological mutations of the gland itself, but apparently it is much more dependent on the thoroughness of the resection. This, it should be understood, has not the slightest bearing on the amount of tissue removed. It has been a matter of frequent observation that where lateral lobe intra-urethral encroachment was not endoscopically demonstrable prior to removal of median bar or lobe obstruction, definite lateral lobe intrusion immediately thereafter became evident. Unless such secondary intrusions are removed, they may be the occasion of later disturbance. One thing, however, is certain—we have yet to note endoscopically any evidence of regrowth along the trajectory of excision. The rational inference, therefore, is that relative permanency is reasonably to be expected from complete canalization of the prostatic urethra, wherein there remains no evidence of lobules along the superolateral portions of the tunnel thus affected.

Economic aspects. The advantages here are obvious. In the cases properly selected and adequately carried out, the method has everything to commend it. To date it can be claimed that this method has met all reasonable clinical requirements. It cannot with finality be regarded as a closed question until further time has elapsed and much supplemental data concerning the bacteriological, cultural, and histological status of the residual prostate, long after operation, have been added to the story.

When it is remembered that the foregoing data concern a new and ground breaking study, it appears to us a gratifying report. With this background of experience and apprenticeship, the next 3 years should be even better. Our good fortune is attributed to the fact that in our early cases, we confined our efforts to the simple, the relatively avascular type of case, and that we did not undertake the larger obstructions until we had mastered both ourselves and the method.

Autopsies were obtained in two operative deaths. Suppurative pyelonephritis was noted in both cases. In one, bilateral renal calculi were disclosed which had not been noted on previous X-ray study. The reason attributed for the outcome in this case was the performance of a secondary revision before urethral convalescence from a prior one had been effected. In the second case with the same findings death was probably due to overzealous instrumentation and coagulation by an associate for troublesome postoperative oozing.

Infection is a real, though apparently avoidable, danger. One should refrain from unnecessary instrumentation during the period of urethral convalescence, at which time local treatment seems interdicted. If there be clots they should be evacuated after which a catheter compression bag may be introduced and, if this is not sufficient, there is no objection and there should be no hesitation in performing cystotomy. This plan is certainly preferable to excessive coagulation with its prolonged urethral convalescence and superadded danger of infection. Infection, we are convinced, can be averted by observing the steps previously mentioned, and by breaking away from the long

established precedent of depending upon such innocuous preparations as boric acid solution, and preparing the operative field by direct application through the panendoscopic sheath of metaphen, merthiolate or similar antiseptic. Finally, by routine pre-operative microscopic and cultural studies of the prostatic secretion, and the refusal to operate upon the infected patient until every reasonable effort has been made to remove the infectious process. Years ago, Alexander called attention to the not uncommon presence of discrete foci of pus in chronic prostatics. Recently, a case was presented to us for endoscopic resection. Fortunately for the patient, a suprapubic prostatectomy was performed. Pathological report revealed the disposition of small discrete abscesses throughout the gland. To have performed endoscopic resection on such a case would have been foolhardy. Patently, we are dealing with something more than a simple mechanical obstruction. Infection may easily be superinduced by excessive coagulation or carbonization of tissue at the time of operation, because of the fear of incidental oozing. Our objective from the beginning has been minimal surface coagulation and focal arrest of isolated bleeders. Regardless of the cutting current used, certain prostates are prone to bleed and the natural inclination is to coagulate extensively. This is a technical error. It is our practice under such conditions to introduce a catheter bag and exert compression at the time of operation for a few minutes longer than the normal coagulation time of the patient. This has proved an effective substitute for electrical coagulation and has materially shortened the period of urethral restoration. Extensive experiments in the construction of such compression bags have been carried out by Charles Bard of this city. Most of them have been literally worthless. Recently, however, an effective bag has been constructed by this firm which has afforded us considerable satisfaction. In this connection, acknowledgment is made to Dr. Robert Herbst for his helpful co-operation.

It is our conviction that in any large series of operations on old men, the operator will at some time or other find occasion for the use of all his faculties and facilities in the protection of his patient. Certainly, we have not had the extraordinary good fortune of some of the reporters of endoscopic operations, wherein it would appear there are no deaths, no operative incidents, and ostensibly the patients live happily ever after.

Endoscopic resection is a microscopic engineering job necessitating a previous comprehension of the normal configuration of the structures involved, the manifold pathological deviations therefrom, the factors of safety, excavation, shoring, electrical energy, as well as optical possibilities, not to mention clinical judgment in case selection, etc. It is evident, therefore, that of the many there are who are able to procure this instrument, few indeed are they who can use it. Our position at this time coincides with the stand originally taken, that endoscopic resection has found a large and important place in the correction of established obstruction; that it offers the one method of prevention of the vicious sequelæ of the encroaching prostate—prophylaxis; that it has very obvious limitations, for details of which reference should be made to our prior publications; that more open surgery should be carried out by some of our overenthusiastic resectionists and that more resections should be done by or under the supervision of the now inflexible exponents of the scalpel. While endoscopic resection has made tremendous progress, this advance will be impeded by its unwise overextension. We believe that each of these methods—the old and the new—has a useful rôle, and it is our patent duty to acquire an intimate familiarity with them and to subordinate prejudice or predilection in the interest of our patient.

The surgery of the obstructing prostate of today involves an appreciation of the necessity of its early recognition as well as its prompt correction when the patient shows his greatest credit balance in resilient arteries and other physical assets, and before he has gotten well along the inevitable road to material depreciation of those assets. Moreover, he can and should have his journey made easier and the road longer. It involves too, an intimate familiarity on the part of the urologist with the precise pathological status of this gland prior to operation, and with all the facts be-

for him, the ability properly to allocate the method to the condition and then adequately to carry it out.

Hobbies with medical men should be exclusively extraprofessional. That the precepts and practices of our predecessors should be respected only in so far as they withstand critical observation and the acid test of time; rather should they be considered as points of departure for better things. Finally, to plod the treadmill of custom is to imply intellectual stasis.

Discussion

Dr. Herman L. Kretschmer, Chicago: As one reviews the many accomplishments in the field of genito-urinary surgery during the past 25 years, the advance which stands out pre-eminently is the development of methods of treatment that have replaced open surgery; namely, the treatment of kidney infections with the ureteral catheter, the instrumental treatment of stone and stricture of the ureter, fulguration treatment of bladder tumors, and the transurethral relief of prostatic obstruction, this having recently been added to the list.

In the relief of prostatic obstruction there are two fundamentally different methods of procedure, and they have been presented to you by Dr. Caulk, the exponent of the punch operation, and by Dr. McCarthy, the exponent of electroresection.

The fundamental objectives to be attained and the advantages over an open operation are the same with either of these procedures. Among the advantages of transurethral surgery over open surgery are the following:

1. A lower mortality rate.
2. A shorter period of hospitalization.
3. Few operative and postoperative complications.
4. A shorter period of pre-operative morbidity, since it is to be hoped that many patients, who have heretofore deferred an open operation, will seek relief at a much earlier period than is their wont at present.
5. As a result of relief of obstruction at an early date, there will be a gradual diminution of serious organic complications, such as severe and protracted cystitis, secondary bladder stone, diverticula, hydronephrosis, and renal atrophy.
6. And finally, many patients, who, for one reason or another, are poor operative risks, and hence are denied major surgery, can now be relieved of their obstruction by transurethral surgery.

Particularly in patients having organic disease are the results gratifying, because having been denied major surgery on account of their condition, these patients, in spite of their co-existing organic disease, have been completely relieved by means of electroresection.

With regard to the short period of hospitalization, my experience has been similar to that of the essayists, and I am in accordance with them as to the smaller number of prostatectomies which they now perform.

Hæmorrhage, a matter which has been stressed by Dr. McCarthy, is of two types: primary and secondary.

Primary hæmorrhage can be controlled in most cases at the time of operation by searching for the bleeding point and touching it with the coagulating current. The urine may remain blood tinged for a few days. When clots collect in the bladder, we evacuate them with the Bigelow evacuating pump, and then irrigate with a warm solution of potassium permanganate. This procedure, as a rule, controls the bleeding.

In secondary hæmorrhage, in which evacuation of clots and irrigation with warm potassium permanganate fail to control the bleeding, we reinsert the resectoscope and visualize the bleeding point. This is treated in one of two ways: either by applying the coagulating current to the bleeding point or by excising the bleeding point.

As Dr. McCarthy has mentioned, the mortality figures vary. It is my opinion that the figures will be higher for a short space of time because many patients are at present being sent in who have been considered hopelessly inoperable; hence when they present themselves they are necessarily poor risks. But all this will be obviated when patients are sent to us early for relief.

Dr. Hinman has presented in a masterful way the sequence of events which occurs in hydronephrosis. The progressive dilatation of the pelvis and renal atrophy are gross changes familiar to all of you. In his work he has shown that the tubules undergo dilatation, collapse, and atrophy and that the glomeruli present congestion. Of great interest is the fact that these changes show a group distribution and are not diffuse and uniform. This early atrophy of certain groups and relative preservation of others is related to the blood supply; and although back pressure is the primary and essential factor, anæmic atrophy is another very important factor in the production of hydronephrosis.

As regards the *rate* of production of hydronephrotic atrophy, Dr. Hinman has shown that this is not influenced by polyuria or oliguria, but that the slightest increase in the degree of renal anæmia by partial constriction of the artery or vein has a marked effect.

His experiments, showing that structural repair of hydronephrotic atrophy and functional restoration are possible, are extremely interesting.

He has shown that an animal cannot survive a complete ureteral obstruction of longer than 2 or 3 weeks if the severed ureter is reimplanted into the bladder and the opposite kidney is removed at the same time, but that a hydronephrosis of three or

four weeks' duration may repair sufficiently to carry on total function and the animal survive, if the animal is allowed to live, a few months after ureteral reimplantation but before opposite nephrectomy, and that a hydronephrosis of thirty or forty days' duration may undergo sufficient repair to perform the needs of excretion sufficiently if the burden is gradually shifted after ureteral implantation by a slow destruction of the compensatory kidney caused by partial obstruction of its ureter.

He has shown that functional compensation of the opposite kidney occurs much quicker than the anatomical, but that when an anatomical compensatory hypertrophy has occurred in the opposite kidney, the repair changes on the hydronephrotic side are reduced to a minimum and whatever reparation is manifested may in time disappear.

One of the most interesting parts of his paper is that dealing with the relation of comparative variations in renal structure to hydronephrotic atrophy. As is well known, there are three routes of mechanical backflow: (1) pyelovenous, (2) tubulovenous, (3) interstitial.

These three routes are applicable in explanation of the mechanism incident to the production of hydronephrotic atrophy. Early pyelovenous backflow permits continuation of secretion until the early mechanical closure of the ducts of Bellini is removed, the pelvic contents then having ready access to tubular lumen, causing a tubulovenous backflow.

There is a fluctuating pressure play in the pelvis and tubules, rising with secretion and falling with the backflow, and diminishing like the swing of a pendulum until all the excretosecretory ducts have atrophied.

Should a backflow fail to occur at the onset, urinary secretion will cease at the height of secretory pressure and the pathological picture of a primary atrophy, and not a hydronephrotic atrophy will result.

REMOVAL OF ORBITAL TUMORS[1]

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THE anatomical region considered when removing orbital tumors at operation is not limited by the bony walls of the orbit and the fleshy covering of the outlet, the lids, globe and fascia, but includes the antrum, ethmoid, and sphenoid bones and floor of the cranial cavity. Tumors which are within the orbit may arise from points outside its boundaries, and the surgeon must be familiar with the regions to which his operation may extend, and be prepared to cope with unexpected complications outside his usual field of operation; or, better, to work in conjunction with a rhinological or neurological surgeon. General surgeons frequently are called on to perform operation on the orbit, but ophthalmic surgeons should be more familiar with operations in this region. Knowledge of the anatomy of the head and of the physiology of the eye is invaluable.

Anatomical barriers of defense against infection are provided by membranous limitation of spaces which become surgical zones in consideration of choice of operation for orbital tumors, and these are not to be overlooked or disregarded. The rhinologist rarely has occasion to enter the orbit to complete operations on the paranasal sinuses by either the external or the internal route. The neurologic surgeon, however, has made possible a relatively safer procedure for removal of tumors within the optic canal and the adjacent regions by means of an intracranial approach, and by decompression has relieved the pressure of intractable exophthalmos from metabolic causes.

Attention has been directed to the utilization of radium and roentgen rays as primary factors as well as adjuncts in treatment of certain types of tumors and pseudotumors of the orbit, and it is to be expected that further experience will justify a wider application of these agencies than has heretofore been recognized.

It is evident that a majority of the tumors that occur within the orbit invade that region alone and may be removed with more or less sacrifice of ocular function. Included in this group are bony tumors, primary and metastatic growths, and growths invading the orbit by extension from without.

True bony tumors found about the orbit are classified as exostoses and as osteomata. By exostoses I refer to proliferations of true bone usually found about the orbit as spicular, rough, triangular projections which perforate the periosteum. They may entirely surround the orbit. Exostoses grow slowly and have little surgical significance. The term osteoma refers to a bony tumor that projects into the orbit from one of the nasal sinuses, always covered by mucous membrane. An osteoma is composed of mucus-lined cells of bone separated by fibrous septums and filled with thick mucoid secretion and fine particles of bone. Osteomata usually arise from the frontal sinuses, occasionally from the ethmoid and sphenoid sinuses. They arise from a small base, grow through expansion of the distal end, pushing aside all tissue with which they come in contact, and produce deformities in the bony structures of the base of the skull. They may extend through the floor of the cranial cavity and lie in contact with the dura over areas as large as 6 centimeters in diameter. The surface of an osteoma is moist, mucoid, and may be infected as it is continuous with the lining of the paranasal sinus from which it starts. The contiguous tissue usually has become thickened and is particularly resistant to infection. The growth of an osteoma frequently causes marked proptosis and deformity of the orbit, and may cause blindness by compressing the optic nerve about the optic foramen. Osteoma of the frontal sinuses involves the orbit in about 90 per cent of cases.

Surgical treatment of bony tumors of the orbit includes intimate knowledge of the structure of the orbit and of the physiology of the eye. Because of accessibility, surgical approach to the osteoma is usually through the orbit. Furthermore, attacking the tumor

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Fig. 1. Incision through skin and subcutaneous tissue about 6 millimeters above the superior rim of the orbit. The brow can be retracted so that the incision lies entirely beneath it.

near its base by the most direct route facilitates removal and sometimes avoids trauma in the bed of the tumor. If the tumor can be removed from its bed by an approach through the orbit, there is little danger of meningitis or of intracranial infection, even though the tumor should lie in contact with a large area of dura. The approach through the cranial cavity, as practiced by some neurosurgeons, has led to an excessive mortality rate which I believe could have been avoided if the tumors had been removed through the orbit. Small tumors invading the orbit from the medial side may be removed with the lateral nasal wall, through the nares.

There is a group of softer bone tumors which does not belong in the category of exostosis and of osteoma. Because they involve the bones of the face, they are referred to as osteomata, although they are of entirely different origin and character. I refer to inflammatory thickening of the bones of the face which gives rise to facial asymmetry and occasionally to proptosis through encroachment on the orbit. One or more bones of the face may be involved in continuous enlargement, or the enlargement may be confined to a single bone. Occasionally, multiple osteomata of this type involve widely separated bones of the face and head. Enlargement in this type of bone disease consists of proliferation and hypertrophy without material change in the structure of the bone. They are vascular, usually fragile thickenings of the central portion of the bone, with slight to moderate increase in the eburnation of the surface. They grow slowly and rarely produce blindness. If the sphenoid bone is involved, the orbital foramen may be distorted and blindness may result from pressure on the optic nerve. Osteomata of this type are most commonly found in the frontal, maxillary, and sphenoid bones. Surgical intervention, fortunately, is rarely indicated.

Bony tumors of the orbit can be removed only by surgical intervention. Bearing in mind that osteomata usually have small pedicles, the logical method of approach would be the most direct route to the base of the tumor. Osteomata usually are rounded on the nasal or superior aspect of the orbit, and usually are situated posterior to the equator of the globe, pushing it forward, downward, and outward. Since they lie underneath the periorbita, it is convenient to approach the tumor by means of incision through the skin and the periosteum, anterior to the surface of the tumor. Working toward the suspected situation of the pedicle, a periosteal elevator or a chisel may be introduced along the side of the tumor, and by gentle, rocking pressure the tumor, with its pedicle, may be dislocated at the base, or, if the pedicle is small, it may be divided by a few sharp blows with hammer and chisel. After the pedicle or base has been divided, it may be possible to remove the tumor in one piece by gentle manipulation. If, however, the tumor should be large and wedged behind the frontal bone, it may be advisable to divide it and remove it in small pieces. Because the roof of the orbit frequently has been eroded, caution should be exercised in the separation of the superior surface of the tumor, which is often in contact with dura where adhesions may have taken place.

It is advisable, if possible, to separate the superior and posterior surfaces of the tumor from the adjacent tissues with a blunt instrument. If the dura has been lacerated in

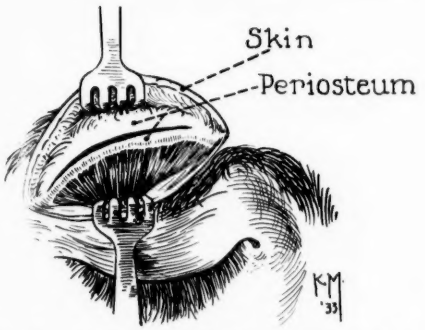

Fig. 2. After the skin and subcutaneous tissues are divided and retracted, all hæmorrhage is controlled before the periosteum is divided. Incision through periosteum above the orbital rim permits accurate reunion by sutures.

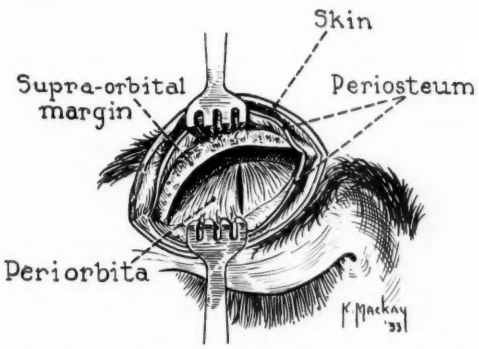

Fig. 3. The periorbita is separated from the roof of the orbit and divided radially in the area most suitable for removal of the underlying tumor.

the separation of the tumor from its bed, the denuded area may be covered by suitable membrane, after which the cavity is filled with normal saline solution and the cutaneous wound sutured water-tight.

A large variety of tumors of the soft tissues of the orbit occur as primary neoplasms arising from the lacrymal gland, from fibrous tissue, from vascular tissue, and from the sheaths of the optic nerve. Within the orbit, also, are found metastatic tumors bearing resemblance to remote organic tissue. Tumors of the nasal accessory sinuses invade the orbit by direct extension. Epithelioma of the lids invades the orbit most commonly along the nasal and inferior walls.

From the standpoint of surgical anatomy there are three areas about the orbit which are concerned in planning surgical procedures for removal of tumors. First, there is a potential space between the periorbita and the bony wall. The periorbita, for the most part, is easily detachable so that there is a potential space between it and the bone. It is firmly attached at the rim of the orbit where it becomes continuous with the periosteum covering the bones of the face. At the apex it is closely adherent to the sheath and upper part of the optic nerve. It is firmly fixed at the lacrymal fossa, at the sutures and various fissures and foramina.

Subperiosteal tumors, such as osteomata, which invade the orbit from the paranasal sinuses, as well as malignant tumors of the soft tissue, can be approached most easily in the following manner: An incision parallel with the superior orbital margin is made through skin and periosteum from the supra-orbital notch to the temporal side below the region of the lacrymal fossa (Fig. 1). The incision should go to the bone, cutting the periosteum a few millimeters above the rim of the orbit. The periosteum is then separated to the orbital rim, where it joins the periorbita (Fig. 2). With some care the periorbita can be separated from the bony rim of the orbit, allowing an instrument to be introduced into the potential subperiosteal space, and the periorbita separated from the bone on the nasal, superior, and temporal walls, well back into the orbit. The globe and other orbital contents can then be depressed, leaving sufficient room for necessary surgical manipulation.

The second surgical space to be considered is the area between the periorbita and the muscle cone. In this area will be found tumors of the lacrymal gland, metastatic sarcomata, carcinomata, primary tumors of the orbital connective tissue, angiomata, endotheliomata, and a wide variety of benign and malignant neoplasms. The method of operation for removal of tumors in this space should be chosen after consideration of the probable difficulties to be encountered in the separation of the tumor from adjacent tissues and of the deformities or disfigurement resulting from the operation. Tumors in this surgical space, that are situated well anteriorly, usually are palpable

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 4. Right exophthalmos of about 8 months' duration from retrobulbar glioma of the optic nerve.

Fig. 5. Eighteen months after removal of the glioma including the entire intra-orbital portion of the optic nerve. Slight exophthalmos persists with moderate ptosis. Ocular movements limited upward and lateralward.

Fig. 6. Same patient as shown in Figure 4, 10 years later. Slight enophthalmos and ptosis. Globe has not shrunken.

through the outlet and are movable, while on the other hand, tumors of the lacrymal gland and tumors that are infiltrating rather than encapsulated are likely to be fixed and firm to palpation. In dealing with fixed, firm tumors in the orbit one cannot determine by palpation through the lids the surgical space in which the tumor may be situated or the character of the tumor. Large, soft tissue tumors have been mistaken for osteomata and surgical intervention deferred, allowing blindness to occur, when early surgical intervention would have prevented it. This mistake need never be made if good roentgenograms of the orbit are studied stereoscopically. More than three-fourths of the soft tissue tumors that occur in this intermediate surgical space can be removed with a minimum of disfigurement through the incision described for removal of tumors in the subperiosteal space. After the periorbita has been separated, as has been described, the globe and other orbital contents can then be depressed, leaving sufficient room for digital exploration. Tumors can be palpated, for situation and size, before the periorbita is opened so that the field is uncomplicated by protruding fat. The periorbita can be incised in the radial (anteroposterior) direction in a position most favorable for removal of the tumor with the least danger of injuring the normal ocular structures (Fig. 3). It is seldom necessary to provide drainage after removal of an orbital tumor, so the periorbita may be closed, the periosteum resutured above the orbit, and the external wound closed for primary healing. The wound should be supported by a snugly fitting bandage.

The third surgical space includes the region within the muscle cone. In this region are found tumors of the optic nerve and its sheath, vascular tumors, and neoplasms of the globe that have perforated the sclera. Tumors within the muscle cone usually cause direct protrusion of the eye, with little or no lateral displacement. They are not palpable through the outlet and are not discernible in roentgenograms. They usually produce choked disk and intra-ocular vascular distention. Tumors of the optic nerve and sheath usually lead to visual disturbances early in their growth, a condition which does not obtain for most tumors of the soft tissues of the orbit without the muscle cone. It may be possible to remove a tumor of the optic nerve without sacrificing the globe. For such purposes one has the choice of two routes. The most de-

sirable from the standpoint of accessibility and minimal disfigurement is by the subperiorbital route described. Because of the peculiar configuration of the bony orbit, it may be more desirable, however, to enter the orbit through a resection of the lateral wall as provided by the Kroenlein operation. It is not always necessary to resect the lateral wall or to remove the globe, as is illustrated by the following case:

A child, aged 7½ years, was brought to the clinic July 27, 1922, with marked right exophthalmos which had been present for about 8 months (Fig. 4). The exophthalmos increased steadily for 1 month, after which there was no noticeable progression. The date when vision was lost could not be determined.

The exophthalmometer reading was, right, 23 millimeters, left, 15 millimeters. The disk of the right eye was pale, the retinal veins were slightly enlarged. Tumor near the apex of the orbit was evident and removal advised.

Incision was made over the right temporal region, starting above and to the temporal side of the brow, curving to the external orbital rim near the outer canthus, thence down and out. The periosteum was incised near the temporal margin and with a periosteal elevator the periorbita was elevated to the apex of the orbit. Through the periorbita a soft mass could be felt behind the globe. The periorbita was incised above the external rectus muscle, which was depressed and not divided. The tumor could be felt within the muscle cone, parallel with the nerve, extending from the globe to the apex of the orbit. The greatest diameter of the tumor was about 1 centimeter, near the globe. At the globe the tumor was not wider than the optic nerve. The nerve was divided immediately behind the globe and at the apex of the orbit after the tumor had been freed, leaving the globe otherwise undisturbed. There were no fibrous adhesions except near the anterior end. The tumor was smooth, rather soft, and white, a glioma of the optic nerve. The periorbita was closed with catgut and the skin sutured for primary union; drains were not employed.

Eighteen months later the child was brought in for observation. The right upper lid drooped slightly, and the right eye was rotated slightly downward. Ocular movements were good except for slight restriction of abduction. The exophthalmometer readings were, right, 18 millimeters, and left, 19 millimeters (Fig. 5). A photograph of the patient, taken 10 years later, reveals about the same condition of the lid and globe (Fig. 6).

The Kroenlein operation is seldom employed for tumors in any other region of the orbit than the posterior third. The difficulty in retracting the lateral wall to provide sufficient space for surgical manipulation, together with the probability of deformity through failure of the wedge-shaped piece of bone to assume its original position, are undesirable features of this procedure.

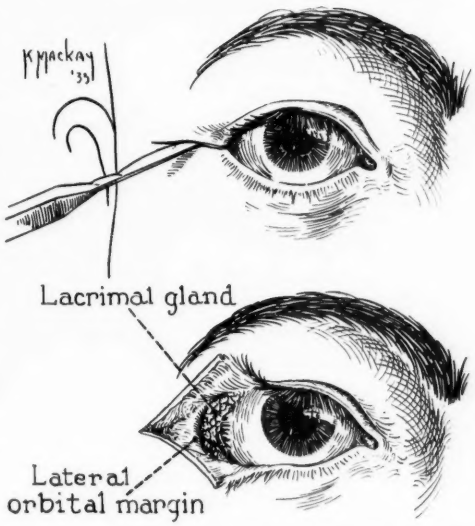

Fig. 7. External canthotomy and exposure of lateral orbital rim and lacrymal gland.

The anterior surgical wall consists of the globe, the palpebral fascia and lids. This is the only distensible wall of the orbit and naturally indicates, through exophthalmos and protrusion of the lids, the size and rate of growth of the tumor. The situation of the tumor, however, can be inferred only by the displacement of the proptosed eye. The point at which the tumor originated cannot be so determined. Retrobulbar tumors may grow to be 1 centimeter in diameter before producing appreciable proptosis. As the tumor increases in size, the globe is pushed forward, not in steady, slow progression, but by stages, as the tumor fills less resistant parts of the orbit. Proptosis of a few millimeters may occur within a few days, and further advancement of the globe may not take place for several months. I have every reason to believe, however, that the tumor causing the proptosis continues to increase in size gradually, although the exophthalmos does not increase in proportion. It is not possible to determine

Fig. 8. Primary melano-epithelioma of the conjunctiva in a man 34 years of age, first noticed 1 month previously as small, black dots resembling embedded gunpowder.

the duration of a tumor by the onset of proptosis, nor can the rate of growth of the tumor be determined by the rate of progress of proptosis.

The method of approach in operating on retrobulbar tumors, therefore, should allow considerable latitude for digital exploration with the minimal amount of trauma. Movable tumors situated anteriorly can be removed through the palpebral fissure. By means of external canthotomy the lids can be widely separated, the conjunctiva divided at the outer canthus, and the globe displaced toward the mesial side (Fig. 7). Access to the lacrymal fossa is readily obtained by this means, and tumors, wherever situated in the anterior third, if they are encapsulated, can be readily removed. Internal canthotomy is to be avoided whenever possible because of the danger of interference with the functions of the nasal duct. Deformities frequently follow incision through the lower lid, as the scar is likely to become adherent to the lower rim of the orbit, thus causing ectropion and a permanently hypertrophied lower lid and conjunctiva. Small tumors within the muscle cone are more easily accessible through wide separation of the lids and, if necessary, resection of the orbit, than by means of the Kroenlein operation.

Extensive malignant tumors of the lids, such as basal cell and squamous cell epitheliomata, that have invaded the orbit require extensive removal of tissue if the tumor has become fixed to the bony wall of the orbit.

Fig. 9. Same patient as in Figure 8. The socket healed and covered with skin of the lids about three months after operation.

Basal cell epitheliomata of the lids are resistant to treatment by radiation and usually send finger-like projections deep into the tissues. These deeply situated cells are rather slow but persistent in their growth. They extend to the bony walls of the orbit, the periosteum becomes involved and the bone actually invaded or necrosed through deprivation of nourishment. The most common route of invasion of basal cell epithelioma is along the nasal and inferior walls. I think this is not because of less resistance in this region but because epitheliomata of the lids in this region are less radically treated in the early stages. A desire to save the function of the nasal duct or other structures found in this region makes one hesitate to use the more radical measures that must be employed to eradicate the disease.

Extensive malignant diseases of the orbit require subtotal or total exenteration. Subtotal exenteration is indicated when the skin of the lids is not involved and so can be used for covering of the socket. The margins of the lids, together with the lashes, tarsal plates, and conjunctiva, should be removed with the

orbital contents. If the periorbita is not involved in the malignant process it is not necessary to sacrifice it. In doing subtotal exenteration of the orbit it never is desirable to retain the margins of the lids and tarsal plates, even though they are not involved, as they are of no use for plastic repair. The socket may become partially filled with healthy tissue and the surface smoothly covered by skin from the lids, as is shown in the following case:

A man, aged 34 years, entered the clinic February 17, 1919, because of pigmented growths in the conjunctiva of the left eye (Fig. 8). These nodules had appeared in the lower cul-de-sac one month previously, as small, black specks resembling imbedded gunpowder. On eversion of the lower lid there appeared a black mass in the depth of the fornix, extending from the inner canthus to the middle of the fornix. The globe was normal and the vision 6-5.

The diagnosis of melano-epithelioma was concurred in by Dr. C. H. Mayo, who advised exenteration of the orbit. The operation was done on February 26, 1919. The major portion of the skin of the lids was used partially to cover the orbital walls after the contents of the orbit had been removed. The wound healed without complications, resulting in a depression in the outlet of the orbit smoothly covered by skin (Fig. 9). There has been no recurrence of melano-epithelioma. The patient returned to the clinic in November, 1932, at which time Dr. A. W. Adson found a glioma of the left motor cortex.

Complete exenteration of the orbit includes entire removal of the lids and the orbital contents with the periorbita. It is indicated in extensive malignant disease of the orbit and is followed by cauterization or irradiation. Dehiscences in the nasal wall of the orbit may occur, and it may be necessary to remove a portion of the nasal wall. It is well to bear in mind, in performing complete exenteration of the orbit, that in elderly people absorption of the superior wall of the orbit brings the periorbita and dura in direct contact, and that the dura may be perforated, leading to infection in the cranial cavity. Great care must be exercised in separating the periorbita along the superior wall. After removal of the periorbita it is very difficult to cover the surface with skin grafts, until fresh, healthy granulation tissue has appeared. During the process of the growth of granulation, exfoliation of dead bone occurs so that attempts to cover the surface of the orbit with skin grafts usually are unsuccessful. The outlet may be closed by a prosthesis fitted to a spectacle frame.

Exploratory operations on the orbit and operations for the removal of orbital tumors should be done under general anæsthesia. Although as a rule, it is not difficult to procure suitable regional anæsthesia, infiltration of the orbital tissues adds to the difficulties of the operation. It is not uncommon to find multiple tumors present or to find that tumors which seem to be small and anterior are accompanied by larger posterior portions which are not movable or easily accessible. Troublesome hæmorrhage, also, is sometimes encountered and may necessitate ligation of the internal carotid artery. One should always be prepared to meet this emergency.

Discussion

DR. RICHARD C. GAMBLE, Chicago: Dr. Benedict's paper is based upon an unusually large experience in dealing with orbital tumors and is inspired by a deep interest in the subject. He has presented the subject in his usual thorough manner and I must admit that there is very little that I can add in the way of discussion. I was most impressed by his versatility in dealing with the various types of orbital growths and wish to emphasize the importance of such versatility. Tumors of the orbit have one sign in common—proptosis, but in other respects there is often great variation. Sarcoma is usually found in children or young adults. It grows rapidly and is often associated with increased vascularity of the surrounding tissues. Most forms are not very radio-sensitive so that exenteration of the orbit is necessary. Even this often fails to save life as recurrences and metastases are common. Tumors of the optic nerve and its sheath grow very slowly, causing early optic nerve atrophy and blindness and later a straight forward proptosis. Sometimes the optic foramen is enlarged. They are usually glioma, neurofibroma, or psammoma and do not cause metastases but may cause death by direct extension into the cranial cavity. Endothelioma usually occurs in adults. It is a benign growth but may recur unless removal is complete. Cavernous hæmangiomata may or may not be associated with superficial vascular growths in the skin. They are present at birth and are often found during childhood. They may, however, not become large enough to produce symptoms until the patient has reached adult life. Radium is much less effective in destroying the deep cavernous lesions than the superficial ones. Conse-

quently, surgical removal is usually required and in most cases this can be done with conservation of both vision and the eyeball. The bony growths, exostoses and osteomata, can be detected with certainty by means of the X-ray, and removed surgically, if necessary. The lymphatic tumors are usually multiple and bilateral. Such tumors are very sensitive to radium and seldom require surgical removal.

Dermoid cysts and oil cysts must be entirely extirpated with the capsule or else they recur. Other causes of proptosis must be kept in mind, such as syphilitic gumma, tuberculosis of the wall of the orbit, meningo-encephalocele, ethmoidal mucocele, extension of malignancy from the antrum, unilateral exophthalmos from toxic goiter, infiltration of the orbital tissues in leukæmia and chloroma, and the so called "phantom tumor," which produces marked proptosis but no mass which can be removed surgically.

My purpose in briefly reviewing some of the characteristics of these various types of tumor is merely to show the value of determining as far as possible the histological nature of the lesion from the clinical examination before deciding upon an operative procedure. The great improvement in the results obtained by the neurologic surgeons in the past few years is due largely to their increasing accuracy in foretelling the histological nature of a growth from its clinical characteristics. I believe the same is true of tumors of the orbit.

Many of the growths in the anterior part of the orbit can be reached satisfactorily through the brow incision, or by way of a conjunctival incision with or without an external canthotomy. For the deeper growths the Kroenlein operation is required. The ophthalmologist should perfect himself in the technique of this operation but, unfortunately, many do not have the opportunity to do so. I see no objection to having a general surgeon make the exposure and then turning the actual removal of the tumor over to the ophthalmologist who is more familiar with the orbital structures.

Diathermy can sometimes be used to advantage in removing extremely vascular growths which are not well encapsulated. The marked lid swelling and œdema of the orbital contents which follows its use would seem to make it of value only in cases in which the eyeball had been removed prior to removal of the tumor.

SURGICAL CORRECTION OF OCULAR DISFIGUREMENTS[1]

MEYER WIENER, M.D., F.A.C.S., St. Louis, Missouri

PLASTIC surgery probably had its birth in India where restoration of punitively mutilated noses was successfully accomplished many centuries ago. This, and the work of Tagliacozzi at Bologna, detailed in his work published in 1597 had either been forgotten or denied, until a revival at the beginning of the eighteenth century. Its reawakening at the end of the eighteenth and the beginning of the nineteenth was due, to some extent at least, to non-medical literature. That the public mind is interested in displaying to the best advantage personal appearance in the way of clothes, jewelry, style, cosmetics and any and every other way of improving personal attractiveness is manifested by the enormous sums spent yearly for these purposes. The development of a pleasure loving people instead of the serious type of former years has created a more urgent demand for correction and improvement of facial defects. I think it would be generally conceded that the appearance of the eyes can be counted on as far more of an asset to one's comeliness, or to detract more from his good looks than that of any single facial feature. The fact that one wishes to have a facial disfigurement corrected does not necessarily mean the mere gratification of personal pride or conceit. One's personal appearance in the manner of dress and neatness; a featural blemish or imperfection, or its correction, may seriously hinder or advance the development of one's economic success. No one can deny that appearance plus personality has a weighty influence in attaining hard won achievement in either a business or professional career. Whether it be an introductory meeting or in the course of an ordinary or business conversation, one's attention is bound to be attracted to a deviation from the usual of the person observed. There are very few who are not made conscious by the instinctive stare of the observer, and thereby placed at a disadvantage.

[1]Presented before the Clinical Congress of the American College of Surgeons, Chicago, October 9–13, 1933.

The medical profession, heretofore in a state of lethargy in this matter, has been aroused by an enlightened and exacting clientele, and is just becoming fully awakened to the vast possibilities, as well as to its important responsibility in this revivified branch of surgery. It is my belief that all ocular disfigurements which may seriously affect one's mental poise should be corrected, provided of course, that this can be done without any undue risk to the individual. It stands to reason that prevention of disfigurement is not to be separated from a discussion of corrective measures.

In our hurried life and congested automobile traffic, injury to the eye and lids is constantly increasing. A cut or penetrating wound of the cornea can be easily overlooked if fluorescein is not immediately instilled in the eye. Through and through cuts of the lid, if properly sutured, leave little or no scar, provided they are cared for early. It is important that the first stitch, after proper trimming, unite the gap in the lid margin and should be placed through the lower margin of the upper or upper border of the lower lid and include a good bite in the tarsus. Using this for traction, the remaining sutures are very easily placed.

Marginal chalazion is often chronic, lasting months or even years. It can be dissipated in a few days by excising a triangular segment with a straight stiff scissors, after first anæsthetizing by ballooning out the retrotarsal fold with 2 per cent procaine solution. No after-treatment is necessary and no scar results. Xanthomata and other benign tumors are best excised under local anæsthetic with a scissors, care being taken to approximate the skin edges with interrupted silk sutures. No dressing need be applied. Sometimes the canthus is pulled away from the globe after an unusually large piece of skin is excised near the corner. It can usually be brought into place by reversible flaps. Large malignant growths requiring excision of a segment of the whole thickness of the lid can be removed, the missing tissue being replaced by a sliding graft from the temple with barely perceptible blemish. The same procedure can be used in correcting coloboma of the lid. Unusually heavy folds of skin sometimes hang down over the edge to such an extent as materially to reduce one's field of vision, especially above and temporally. These folds are excised with straight scissors and the skin edges are carefully approximated with interrupted silk sutures. No visible scar results. I have seen such folds occur as a hereditary trait, and I have had to correct this most embarrassing peculiarity in more than one member of the family.

Removal of unsightly scars of the lids or in close proximity to the eye will often greatly improve one's comeliness. No set rule can be followed, the method depending on the location, depth, character, and extent of the scar tissue. Hyperplastic ectropion, a most disfiguring condition, can be immediately and dramatically corrected by use of the Ziegler method of cauterization. This is also the case in the less defacing but more uncomfortable condition of spastic entropion. Symblepharon, and contractile entropion and ectropion must be corrected by skin replacements, either pedicle, Wolfe, Thiersch, or epithelial buried grafts after the Esser method. The choice of method depends largely on type of defect and on the condition of the surrounding tissues.

Ptosis may be corrected by utilizing either the power of the superior rectus muscle to raise the lid or the occipito-frontalis. The first is the method of choice, provided of course, the superior rectus is not paralyzed. The open-Motais operation is the one which gives almost ideal results when successfully performed. The outcome is precarious on account of the very small strip of tissue available for this purpose. About the same time that Motais announced his operation, Cannas, using the same principle, reversed the course, and advocated attaching the levator to the superior rectus tendon. For some unknown reason this was never given much consideration. I have even failed to find mention of it in English or American literature. It seems to me to fill our utmost conception for proper correction of paralysis of the upper lid.

Where the superior rectus is paralyzed, the use of strips of fascia lata after the method of Lexer has been most satisfactory in my work.

A useless, unsightly eye should be removed for reasons of safety, comfort, and appearance.

When an eye is enucleated neatly and with proper technique so that only the capsule of Tenon is exposed and the fat of the orbit not disturbed, little or no disfigurement results, especially if a suitable foreign substance is sewed into the capsule of Tenon so as to fill out the socket. Then, with a well matched reform eye, it is difficult for even an expert to discern the difference under ordinary circumstances.

If there has been abscess formation, chronic dacryocystitis mars one's looks considerably. There is a difference of opinion among ophthalmologists as to whether the sac should be extirpated or an artificial drain made into the nose. I have not taken out a sac for over 15 years, as I find that the intranasal method is most satisfactory from the standpoint of function, while there is no defacement whatsoever.

Widening the palpebral fissures is, in my opinion not utilized to its full advantage in this country as it is on the continent. There are cases in which it not only improves the patient's appearance, but may add much to his comfort as well.

In another condition, facial paralysis, the patient can be given a great deal of physical relief as well as adding greatly to his appearance. A V-shaped piece of skin, the full thickness of the lower lid, taken away from the temporal portion of the lid, reduces tearing, lessens the opportunity for infection and improves the looks. One of the most grateful patients I have is an elderly man who almost had to beg me to operate on him to relieve his embarrassment due to this deformity as well as the annoying discomfort.

Large vessels of the conjunctiva sometimes give great concern to the patient and he is more likely to be a man than of the gentler sex. I have often destroyed these with the electric needle with little inconvenience to the patient.

Pterygia certainly do not add to beauty, and besides they have a tendency to grow and interfere with sight. I find that when the underlying involved corneal tissue is dissected back, along with the conjunctival tissue, a recurrence almost never occurs. For thick, recurrent pterygium, a small epithelial graft slipped under its base, after the corneal part has been carefully removed, will prevent its ever again overriding the cornea.

Tumors of the cornea and conjunctiva, even when malignant, can usually be removed with little or no resulting scar. Corneal scars, when there is no anterior synechia, can be dissected or peeled off with no noticeable opacity and often greatly improve the vision. Where there has been perforation with anterior synechia resulting, beautiful results have been obtained by tattooing with India ink. A moderate sized staphyloma is best reduced with the electrocautery. If the staphyloma is at all extensive, enucleation with implantation in the capsule should be done, as one is apt to come to grief by temporizing with some of the resection operations. I need say very little about muscle work, as the profession has been awakened to the advisability and even necessity of operative interference in this class of cases. Even in case of paralytic squint due to paralysis of the sixth, the practice of correction by operation is growing among the eye surgeons. Paralysis of the third nerve produces a most embarrassing disfigurement. If one operates to correct the drooping lid, the deformity is almost as bad as before owing to the exposure of the widely diverging eye. This can be greatly improved; in fact practically corrected by cutting the superior oblique from its pulley, greatly shortening it, and transferring it to the attachment of the paralyzed internus. It must be placed slightly above this insertion in order to avoid deviation upward. This procedure was described by me a few years ago.

I have seen the inferior rectus severed from its attachment as though by a sharp knife as the result of a man walking at night against a wire used as a clothes line. The upward deviation not alone greatly disfigured the man but prevented his continuing his trade as a carpenter on account of the double vision. The tendon was picked up with surprisingly little difficulty, the eye brought down to its proper position and the man relieved of his diplopia except in looking way up. This did not seriously hinder his work.

I have not infrequently removed a cataractous lens in a blind eye for the sole purpose of improving the person's looks. I have not

sufficient time to cover the subject in full, but I hope that I have presented ample material to stimulate an added interest among my fellow ophthalmologists to consider the mental aspect of his patient as well as the mere restoration of physical function.

Discussion

DR. SAMUEL J. MEYER, Chicago: Dr. Wiener has had a long rich experience in ocular surgery, and fortunately, has given much thought and time to the correction of ocular disfigurements and their function restoration, which to my mind is of the utmost importance to the patient.

While the esthetic improvement of the patient's appearance is the ultimate end to be desired, we as surgeons must first consider the function restoration of the parts involved as the most important to be attained. The release of cicatricial contractions in the area of the orbit is the essential preliminary to the restoration of lost function. One must not excise an area of scar tissue before he is absolutely certain that the replacement which follows excision will not lead to new loss of function later on. This necessitates a thorough study as to the nature as well as to the source of the replacement material so that one can be certain of the permanence of the restoration.

There must be a sound physiological basis to every procedure attempted, and this also involves a study of the anatomy and histology of the parts involved. This relates especially to situations which involve the skin, as in such cases the end-results of the plastic operations performed are exposed to the view of all.

There is also an esthetic point of view which we have to consider. The surgeon has to consider the extent of the loss involved in the disfigurement of the patient. That loss may include, besides impairment of function, loss of the ability to earn his living because of the sensitiveness of others to his appearance, or loss of the prospect of marriage, or a let down in his own estimation, or loss of courage with which to face the trials of his station in life, with resultant grave psychic and ultimately physical depression.

We must also consider that the various muscle anomalies such as the convergent, divergent, and vertical deviations result in functional derangement of the binocular vision, and any procedures that may correct these defects may so improve the functional capacity of the patient that the time and labor involved on the part of the surgeon will be justified. We have all been faced with cases involving a paralysis of the sixth nerve and the secondary convergence that follows. An attempt to correct this disfigurement should be made by employing the technique advocated by Hummelsheim, in which the lateral halves of both the superior and inferior recti are dissected free and re-inserted under the insertion of the external rectus tendon. This method may occasionally result in definite improvement of the defect.

I first learned of Dr. Wiener's advocation of retrotarsal fold injection of novocain 2 per cent for chalazion operations about 4 years ago, and can heartily recommend his suggestion. This method does not result in any ballooning of the tissues in the immediate vicinity of the chalazion, therefore, does not distort the landmarks, and usually results in excellent anæsthesia.

Besides the conventional method of using India-ink in tattooing the cornea after preliminary scarification of the epithelium, one may resort to the use of gold chloride or platinum chloride, which is reduced by means of tannic acid or sodium hydrazin. Recently Jasinki reported a new method which is free from irritation and yet produces good cosmetic results. The epithelium of the cornea in the area to be tattooed is removed, a tightly wound cotton applicator saturated with silver nitrate 2 per cent solution is applied for a period of 2 minutes, care being taken that no excess fluid runs upon the cornea. The applicator is removed and the area reduced with a 2 per cent solution of sodium sulphide applied in the same way for a period of half a minute. The cornea is then irrigated with salt solution. Some slight opacification of the cornea occurs, which disappears within the following 3 to 4 days. There is very little reaction, and the epithelium is regenerated within a week or so. It results in a beautiful brown color, and may be used in tattooing the peripheral areas of the cornea.

Three methods or types of operation must be considered in the correction of ptosis cases. Advancement of the levator muscle (Everbusch method) is indicated only in cases of incomplete ptosis, as it does not produce satisfactory results in cases of complete ptosis. A union of the upper lid with the superior rectus muscle (Motais method) often results in lagophthalmus, especially during sleep on account of Bell's phenomena. A lagophthalmus with a resultant keratitis results in about 15 per cent of cases operated upon by this method. Dr. Wiener's method so aptly illustrated by the lantern slides just presented sounds logical from a physiological point of view, and while I personally have had no experience with this method, I shall attempt to employ this technique when opportunity permits, in the hope that I may obtain equally satisfactory results. The third and probably best type of procedure is the union of the lid with the frontal region (Hess method), of which there are several modifications, the Macheks operation being quite satisfactory. We no doubt have all had considerable failures with the various ptosis operations, and any technique which may improve our end-results is certainly worth trying.

To obtain a good foundation for a reform eye after enucleation, I believe that the use of a fat implant taken from the patient's hip, inserted into the capsule of Tenon and then closed over by suturing the cut ends of the recti muscles gives as satisfactory a stump as can be made. This obviates the use of foreign substances such as glass or gold balls or bone spheres, which may at any time act as foreign bodies and be extruded.

In facial paralysis one may decrease the extraordinary width of the palpebral fissure with its resultant tearing, etc., by doing a canthoplasty according to the method of Elschnig. This method also results in a better functional and cosmetic result and is a very simple surgical procedure.

In the treatment of pannus and other pathological conditions involving the formation of new blood vessels on the corneal surface with its resultant loss of corneal function and luster, one may resort to diathermy peritomy with comparatively good results. The technique is simple and the patient is not incapacitated.

ECONOMICS IN OTOLARYNGOLOGY[1]

B. R. SHURLY, M.D., F.A.C.S., DETROIT, MICHIGAN

OUR fee system should be readjusted to meet the changing value of the dollar. The times call for a rapid adjustment of expenses in the hospital, office, and home. Until the overflow and waste can be checked, the building of new hospitals, additions, and medical schools should be stopped. The costs in nursing and hospitals should be revised to conform to the supply and demand. The public should be taught the value of the services of a certified otolaryngologist as compared with that of the untrained man. Post-graduate study in qualified centers should be encouraged. The use of the United States Pharmacopeia and National Formulary should be resumed for drugs and solutions.

The plan of paying the attending and assistant staff in the medical school, hospital and clinics should be promoted. The teaching of bookkeeping, elementary law, the value of money and the methods of banking, major psychology, and the study of human relations should be included in the premedical course.

The profession should pay more attention to the study of organized medicine and the specialties so that we may be better prepared to exercise more power in the control of state medicine. State medicine should be regulated to a police function and the care of infectious and contagious diseases. All pay cases should be returned to the family physician, the qualified specialist, or the private hospital which now is running at one-third capacity while the taxpayer attempts to pay the bill for the municipal hospital.

Appropriations of universities and municipal hospitals should be cut to provide only for the number of beds required for teaching and emergency cases. All teachers in the medical schools should be paid an honorarium or better. All school and out-patient department physicians and specialists should be paid the cost of services or better. Contract practice and industrial medicine should be eliminated except for emergency service, the choice of physician or specialist being left to the patient. United States Government hospitals with staffs should be eliminated except for disabilities directly attributable to, or contracted during, service. In the Army, Navy, and Veterans Bureau hospitals only specialists qualified in their fields should be allowed to serve.

The county medical society should visé all contract practice and it should devote more time to the study of economic subjects.

If the earning power of the otolaryngologist is to increase it must be along the lines of borderline surgery and those of better general medicine.

If we are to have the confidence of the people, fee splitting must be stopped.

[1]Abstract of paper presented before the Clinical Congress of the American College of Surgeons, Chicago, October 10, 1933.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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FEBRUARY 15, 1934

THE 1933 CLINICAL CONGRESS IN CHICAGO

THE twenty-third annual Clinical Congress of the American College of Surgeons was held in Chicago, October 9 to 13, 1933. The most realistic soul could not have witnessed the colorful convocation which ended the session, without realizing how much water had flowed over the dam since May 5, 1913, when 450 surgeons, meeting in Washington, organized the American College of Surgeons. This organizing committee had been appointed by the Clinical Congress of Surgeons of North America, an institution which, in its turn, was the outgrowth of the efforts of SURGERY, GYNECOLOGY AND OBSTETRICS to tighten the bonds, stimulate the professional interests, and elevate the science and art of American surgeons. The hope that all this could be accomplished has now grown into a tradition.

With one variation the five-day program was carried out on a plan generally similar to that of previous sessions. In broad principle the meetings were devoted to scientific addresses; public health instruction for intelligently interested laymen; hospital standardization conferences; symposia on clinical topics, featuring in particular the curability and arrestability of cancer; the diagnosis and treatment of fractures and the relation of industry to medicine; and operative clinics were held in approximately fifty of Chicago's approved hospitals. The unusual variation mentioned was a meeting held on Sunday night previous to the opening of the session in the Hall of Science at A Century of Progress, at which addresses of welcome were delivered respectively by Mr. Rufus Dawes, president, and Dr. William Allan Pusey, chairman of the section on medical sciences of A Century of Progress. A chorus of 1000 Chicago nurses in uniform sang, various members of the American College of Surgeons responded to the addresses of welcome, and greetings were extended by representatives from foreign countries.

A meeting of the sort that was held in Chicago, indeed all of the meetings of the Clinical Congress that have preceded this one, may be reviewed with two thoughts in mind,—one could set about to picture the various programs of the five dynamically active days and present them *en résumé*, for the delectation of unfortunate members who were unable to attend; or one could point out the general significance of such a gathering. It seems that in the direction of the latter alternative lies the larger interest. The various addresses and scientific communications will appear in print, likewise the various symposia; the profit from the operative clinics will spread by word of mouth; the high lights of the conferences on hospital standardization

and on industrial surgery will be discussed, and either adopted or considered by various boards and institutions; but the soul and spirit that fuses out of over 3000 guild men, in common meeting, is something that calls for comment, lest it be lost in the already mulling crowd of other lost souls. One may generalize broadly, without in any way minimizing the individual efforts of men who, like Dr. Philip H. Kreuscher, bore the brunt of responsibility of arrangements, or like the director general, Dr. Franklin H. Martin, and his efficient aids, who provided all advance planning and ultimate functioning of the plans; indeed, painting the picture with a broad brush does not lessen the value of any of the individual scientific contributors.

The point is just this: Once a year a large and representative body of American surgeons, re-enforced by a small leaven of foreign colleagues, assemble for the accomplishment of a definite set of purposes. The success of these congresses, year after year, lends a traditional force to these gatherings that transcends in power and influence almost any other motive that could be devised to elevate surgery to the level she merits; nothing other than tradition could do this. Preachments, legislation, fine example in high places, formal codes of ethics, all are as mere reeds to lean upon compared with the solidarity of purpose that is born of the execution of practical ideals.

The ideals motivating these annual meetings are manyfold: The annual induction into the company of surgical scholars and practitioners of a new group of thoroughly tested men; the emphasis that is laid, year after year, on the duties and obligations of service; the newer gospel to laymen, teaching them that they are partners in the glorious adventure of surgery, entitled to know all that they wish or can understand; the persuasive arguments presented to industry to prove that wise and provident medical and surgical care of employees will improve both industrial conscience and industrial profits; and finally the offer to the large public of hope and cheer, based on accurate scientific deductions—the hope that they may preserve their health if they know how to look after it, even though they be afflicted with that ogre of diseases, cancer.

Granting that such are the aims and objects of the meetings of the Clinical Congress of the American College of Surgeons, may any one doubt that their accomplishment can, by any chance, fail to inspire the world with a larger faith in surgery, and surgeons with a stronger faith in themselves? M. G. SEELIG.

PAPERS NOT INCLUDED IN THESE TRANSACTIONS

In publishing the Transactions of the twenty-third Clinical Congress it was found necessary to omit therefrom two important contributions which will appear in revised form in later issues of this journal. These two papers are: (1) The fracture oration, "The Treatment of Fractures Involving the Joints," by W. E. Gallie, M.D., F.R.C.S., of Toronto, Ontario; (2) a contribution to the symposium on diseases of the thyroid, "The Treatment of Exophthalmos," by Howard C. Naffziger, M.D., of San Francisco.

PRESIDENTIAL MEETING, CONVOCATION

ADDRESS OF WELCOME[1]

PHILIP H. KREUSCHER, M.D., F.A.C.S., CHICAGO

CHICAGO welcomes the twenty-third Clinical Congress of the American College of Surgeons. This year in our city A Century of Progress in art, science, and industry is depicted to the world. This year the Clinical Congress completes its first twenty-three years with demonstrations of advancement in the art and science of surgery.

It is fitting that this anniversary should be celebrated in this city—the home of the American College of Surgeons, the home also of our esteemed Director-General, founder and former president of the College.

Chicago glories in having been the scene of the activities of John B. Murphy, the greatest surgical teacher of his age, a dynamic chief, a taskmaster extraordinary, a life-long inspiration to those of us who were privileged to enjoy years of daily association.

We are proud of the Chicago men who pioneered in surgery. The names of Fenger, Senn, Andrews, Ochsner, and Murphy are venerated the world over where surgery is taught. These were men of vision, of extraordinary ability, of outstanding genius. They made history in surgery. Those of us who sat at their feet are attempting to carry on. We hope to pass on to you in the surgical operations and demonstrations which you will witness during the next few days the benefit we derived from intimate contact with these great masters.

We in Chicago are proud to open the doors of our five Class A medical schools and our fifty accredited hospitals to you. Nowhere else in the world will you find a more impressive center of surgical science concentrated within so few miles.

Since the Clinical Congress last met in Chicago, the Cook County Graduate School of Medicine with its almost unlimited facilities for clinical instruction, has been launched. Its conspicuous success in the face of the protracted economic crisis attests the value of its service and the demand for such an institution.

The Chicago Chapter of the Fellows conducts and maintains the nationally known *Daily Clinical Bulletin*, which is at the disposal the year round of all those who wish to attend clinics.

For a year we have awaited your arrival. We have prepared to help you get the most during your short stay in Chicago from all of our institutions, and from the men who lead them. The feast, which we hope will prove sustaining, is all prepared. Partake of it freely.

We hope our hospitality and entertainment will equal the exhilarating vigor of our city, a vigor which Carl Sandburg has expressed in his poem "Chicago" in such phrases as these:

"Come and show me another city with lifted head singing
so proud to be alive and coarse and strong and cunning.
Flinging magnetic curses amid the toil of piling job on job,
here is a tall bold slugger set vivid against the little
soft cities—
Under the terrible burden of destiny laughing as a young
man laughs,
Laughing even as a fighter laughs who has never lost a
battle."

This city, which has inspired so many men to great achievements, lays the fruit of their intrepid labors before you. We hope you may glean something from the cumulative attainments of our men and institutions that will be of lasting benefit to you in the care of the sick and injured. May Chicago remain in your minds not only as the dynamic "Windy City," but also as a center where men and women are earnestly engaged in advancing the profession of making happy and useful citizens of those who might otherwise have been burdens to society.

[1]Presented before the Clinical Congress of the American College of Surgeons, Chicago, October 9–13, 1933.

THE STORY OF A MASTER SURGEON[1]

LOYAL DAVIS, M.D., F.A.C.S., CHICAGO
Professor of Surgery, Northwestern University Medical School

The fishes that go deep in the water may be hooked; birds that go high in the air may be shot; but man's heart only is out of our reach. Chuang-tse.

IN 1839, an Irish girl of twenty named Grimes and her seven brothers left County Clare to seek their fortunes in America. They landed in Boston where they remained while the eldest brother Thomas, who had received a college education in Ireland, left upon a reconnoitering expedition to find a home. After a considerable period of wandering in the country west of the Alleghenies, Thomas Grimes settled in Wisconsin on a tract of land now a part of the Town of Menasha in Winnebago County and sent for his sister Ann and six brothers.

An Irish lad, Michael Murphy from County Limerick, had reached Wisconsin about the same time. It is not certain when Ann and Michael met but they were married in 1849, when each was about thirty years of age. They went to live on 120 acres of land, a mile and a half north of the Grimes homestead. Whether or not this was a part, or all of the dowry, or whether the educated brother Tom sold it to his prospective brother-in-law we can only surmise. Certain it is, however, that Michael had to clear his farm from the wilderness of heavy timber. The land, consisting of rolling uplands and gently sloping valleys, was well supplied by the Wolf River and its tributaries. Water was easily obtained and the soil of red clay deposit, mixed with a rich limestone loam, made particularly fine wheat land. He erected a spacious log cabin 28 feet square with 2 rooms downstairs and a large, unpartitioned upstairs.

In the winter of 1850, Ann Grimes Murphy gave birth to her first child, with the care only of her husband and a neighbor woman who had come some distance to attend her. Seven years later her fifth child and third son was born, four days before Christmas. Of the six children she bore, he was destined to be one of three who lived beyond the age of thirty-eight years and, influenced no doubt by the early deaths of two brothers and a sister, was to be apprehensive always of his physical vigor. It cannot be doubted that the Grimes inheritance influenced the family and supplied the incentive which placed one boy in the priesthood, a daughter in the sisterhood of the Church, and made of another America's most brilliant and colorful teacher of surgery.

A graduate of the country schoolhouse, Johnny walked the four miles between the township of Grand Chute and Appleton to attend high school. During the school week he lived with Mother Driscoll, whose own boy had decided upon a broader education in the Navy. Each Monday morning he carried bacon, milk, and eggs to pay in part for his board and room. After school hours, he spent his time in Alexander Lewis' drug store above which Dr. H. W. Reilly kept office. Lewis' prescription pads served for working out chemistry formulæ and for signing "John B.," "John Benjamin," and finally, "J. B.," which it was always to remain. He had chosen a middle name from a list suggested by his girl cousins as appropriate for an ambitious and serious minded young man. He was taught chemistry and related subjects in science by Professor Schmidt whose ability as a teacher won his enthusiastic admiration, and whose personality influenced Murphy to become a school teacher. After assuming the tutorship of five others who wished to take the teacher's examination and guiding them through successfully, the tall, slim youngster was granted a certificate to teach and was assigned to the Nichol School, a mile and a half north of his home. However, after two terms the doctor's office above the drug store drew him back and he began the study of medicine with Dr. Reilly as his preceptor. The function of the pupil was to make himself useful about the office in doing dressings, putting up powders, making pills, keeping the office clean, running errands, accompanying the sponsor on calls, and, in general, being an all-round handy man for the doctor and his household. He might be assigned Gray's *Anatomy* or Draper's *Physiology* for one year, and at the end of that time be allowed the privilege of paying an honorarium of two hundred dollars or more to the preceptor. By the fall of 1877, "J. B." was armed with his preceptor's certificate of study and more knowledge of the art of the practice of medicine than most present day graduates ever acquire.

Rush Medical College, where he entered and graduated in the Class of 1879, had been in existence for thirty-six years. It had come a long but

[1]The John B. Murphy Oration in Surgery, presented before the Clinical Congress of the American College of Surgeons, Chicago, October 9–13, 1933.

dilatory way from its wobbly beginning in two rented rooms and a faculty of four, which had been assembled with no little difficulty. Since the only income of the early medical schools came from the fees of students alone, each school feared to raise the requirements because students might be driven away. Though in solemn conclaves devoted to educational reforms such provisions were constantly advocated, the trustees always went home to vote the other way. It was possible to be graduated from one of the best medical colleges in the country after attending two identical courses of lectures without having looked through a microscope, without having taken a medical history, without training in physical diagnosis, and without having seen a case of labor. Because of the danger of infection, the field of surgery was limited and the teacher of surgery confined his operative efforts to amputations and the more superficial surgical procedures. We may find it difficult to visualize the surgical amphitheater of Murphy's student days. The surgeon and his assistants operated in their ordinary street clothing. It was an achievement worthy of a professor to amputate a leg without soiling his cuffs. One of the foremost surgeons of Boston invariably entered the operating room, where the use of ether had first been demonstrated, with a final glance in the mirror at his perfectly tailored dark blue Prince Albert and the rose in his buttonhole. All of the physicians of Chicago attired themselves in long-tailed, black broadcloth frock coats buttoned tightly to the chin.

The lack of accurate scientific knowledge about pathological processes which are today commonplace to us made it necessary for the doctor to develop other attributes which were designed to impress his patients. An air of mysticism hung over the medicine of that period. The people themselves aided and abetted the development of these mannerisms of dress and speech. They had no particular liking for cold facts, even though they were few in number. They did admire metaphysical discussions, poetry, ambrosial locks, flowing whiskers, and sometimes the rolling eye. These were signs of wisdom. It was natural for the young medical student to ape his elders in speech and appearance. In Murphy's class of 121 men there were few indeed who had not grown a silky beard to add to their dignity; a dignity which did not bear close scrutiny among themselves since their recorded pranks were of the crudest.

At that time only the students of two of the medical schools in Chicago were eligible for interneships in the Cook County Hospital, a service, however, which was not required of the graduate who wished to enter medical practice. Each year the examination was quite an event and was attended by the senior classes of both institutions. The picked students from each school were ushered into the pit of the large amphitheater of the hospital and assigned chairs arranged in a semicircle. The spectators of this oral examination offered free and pointed advice to the candidates. The spectacular and eminent professor of surgery at Rush with his long curls, bushy side whiskers and mustache, and his gold rimmed eye glasses, held by a fancy gold chain, was observed and admired by all. Several other distinguished teachers from each school completed the examining board. The replies of the tall, slim, whiskered Irishman aroused the interest and sympathy of his audience. His responses were quick, decisive, and evidently quite correct. He successfully parried all attempts to confuse him and the ease, alertness, and assurance with which he accomplished this won him first place.

The capacity of the County Hospital was 450 patients and there were six internes in surgery on two services. The service Murphy chose had always had a reputation for being the better and maintained that tradition through the work of McArthur, Meacher, Billings, and those who followed. One of his first duties was to use the carbolic acid spray of Lister. Each patient was sprayed with a 5 per cent phenol solution and then the wound was dressed with eight successive layers of gauze; followed by a piece of McIntosh and finally by the ninth layer of gauze. No one has ever told us of the function of the last piece of gauze.

One of his attending surgeons was Dr. E. W. Lee, with whom he became associated after completing his interneship in 1880 and with whom in 1890 he wrote his first medical article in a privately printed monograph which was entitled "On Early Operation in Perityphlitis." This paper included the report of the first operation for appendicitis in the modern understanding of that surgical procedure and was performed by Murphy on March 21, 1889. Their office was at the corner of Halsted and Harrison Streets, a block from the corner which Jane Addams nine years later was to choose for her social work at Hull House and which was destined to be the center of Chicago's population. In the fall of 1882, Murphy left Chicago to go abroad for study. While in Vienna, in 1883, he had a few attacks of hæmaturia and immediately consulted one of his professors at the Allgemeines Krankenhaus. He was told that he had tuberculosis of the right kidney and it was suggested that he leave Europe at

once. This diagnosis concerned Murphy because he had lost a brother and sister in their youth from pulmonary tuberculosis and had always taken great care never to expose himself in inclement weather; in fact, the fear of this disease haunted him throughout his life. His thin chest reminded him daily of its possibilities. So conscious was he of his slender chest that he had his coats padded about the shoulders to give an appearance of robust muscularity. Upon receiving the diagnosis of the Vienna surgeon he started for home; but before he reached the German border his hæmaturia ceased, never to return; his fears disappeared temporarily, and he remained in Europe until the spring of 1884. He then returned to the office with Dr. Lee to widen his experience in general practice. It was not long after that he was called to the Throop Street home of C. A. Plamondon whose daughter, Jeannette, later to play so vital a part in his destiny, was ill with typhoid fever.

When the near West Side of Chicago was young, it was very fashionable. The Great Fire had driven thousands of families toward it. Streets which are now hideous and ill-kept were then bordered by large shade trees and comfortable gray and brown stone homes. There were schools and churches, a few of which still linger, ugly and pathetic. Bridle paths, fine carriages and horses, Easter Sunday morning processions of fashion, the home of the large headed, heavy-bearded Kentuckian who was Chicago's Mayor, all were a part of the neighborhood of the socially elite. To this group of Chicago's first families Jeannette Plamondon belonged.

In spite of considerable competition for the hand of a very beautiful, black-haired girl of eighteen, Murphy's ten years seniority, his professional degree, and his favorable impression upon the family turned the scales in his favor. November 25, 1885, marked the beginning of a partnership remarkable in the manner in which a young girl not only assumed the duties of a doctor's wife but gradually made herself an integral and indispensable part of his daily routine. Were it to assume a defect in hearing to save him embarrassment when introduced to a doctor whose name he had forgotten, were it to assume part of the load of criticism, or to handle all of the family's business transactions, she was always equal to the task.

After a short honeymoon in Wisconsin, Murphy and his bride went to live at 36 Throop Street, the home of her parents. Shortly afterward, a house was built for them a door away. In the barn back of their new home they worked together on his experiments in intestinal anastomosis. She found time to feed and nurse his animals while he was busy with his rapidly growing practice. It was she who found the first button which had been passed successfully by the experimental patient. Her ambitions for his success and the position of her family in society, her business sagacity, her shrewd ability to judge men, all influenced him beyond one's capacity to measure. Like many men who preceded him and others who have followed, Murphy, gradually and without ever being aware of the fact, became more a Plamondon and less and less identified with his own relatives.

May 4, 1886, the spring following their marriage, marked another outstanding date in Murphy's career. On that day 10,000 men had met on the prairie at Blue Island Avenue and Wood Street where they had been addressed by several agitators. Shortly after the closing hour of the McCormick Harvester plant they marched upon its gates, hurling stones and shouting, "Revenge; working men to arms!" Other disturbances in lumber yards and tailor shops had caused an editorial comment to the effect that "many workers were affected with a malignant form of the eight-hour malady." These were preliminary to the famous protest meeting which had been advertised widely by snipers which stated, "Attention Workingmen, Great Mass Meeting, Randolph Street between Des Plaines and Halsted, 7:30 p.m." The meeting was called for Haymarket Square—the goal of farmers driving to Chicago—but it really was held in an alley a few yards north of Randolph Street. Beside the Des Plaines Street police station Captain Bonfield had assembled a small army of policemen and was determined to disperse the remaining 600 whom rain had not discouraged. He marched his men north across the square and to the mouth of the alley, where, under torch light, Fielden with Parsons and Spies were haranguing the crowd, and ordered them to disperse. As the muttering mob was about to scatter, a loud explosion was heard and a large gap was seen in the ranks of the officers.

The alley, which now seems too narrow for a mass meeting, was filled with the wounded. Eight policemen died of their wounds, and sixty-eight were wounded but survived. How many of the mob were killed and wounded no one ever knew.

With several other doctors, Murphy was driven to the Des Plaines Street station about eleven o'clock. The wounded were lying in pools of blood on the first and second floors. Horrible shell fragment wounds of the abdomen, chest,

and lower extremities were dressed hurriedly to arrest hæmorrhage before the patients could be removed to the County Hospital. Murphy personally gave first aid treatment to about thirty wounded men and later continued their treatment at the hospital. The importance of his testimony at the trial of the anarchists was based upon the description of the wounds as having been produced by shell or bomb fragments and not by pistol bullets.

The attention of the public was quite naturally focused on the recovery of the wounded policemen and their medical attendants, and Murphy received his share of the publicity. That he received anything more in the way of reward is extremely doubtful. Certain it is that he received no part of the fund, totaling $48,000, which was raised for the support of the wounded men's families and which formed the nucleus of the first pension fund for municipal employees in this country. There have been those, however, who have insisted that Murphy's fee was enormous and that he sued the city for payment, notwithstanding that there is no court record of any such suit ever having been filed. To read his own detailed description, now in the Court records, of the nature of the wounds and his manner of treatment, gives one an insight into his dogmatic methods of practice and teaching as well as a realization that his surgical judgment was far in advance of his times. He could not resist lecturing the court and attorneys upon proper methods for the surgical treatment of gunshot wounds, and interestingly enough, the court overruled all objections and he was permitted to enumerate the salient features of each case he had treated.

In February, 1887, Dr. and Mrs. Murphy lost their first born, a six weeks' old boy, of diphtheria. Two years later the ghost of tuberculosis came stalking into the young household. Always apprehensive of his lungs, he had been told by a Chicago physician that he had pulmonary tuberculosis. A New York consultant disagreed with this diagnosis but it was confirmed by another in Philadelphia who advised him to go to Florida and live as long as he could. He returned to Chicago and with wife and a three weeks' old daughter left for Las Vegas. He remained in the West for six months and then at Christian Fenger's suggestion went to Berlin to consult von Leyden. The latter agreed with Austin Flint that there was no evidence of tuberculosis. It was at this time that he brought home the first Koch lymph—now tuberculin.

Returning home greatly improved in health he plunged into his rapidly growing practice and his experimental animal work, carried out amidst great difficulties in his own home, and without the benefit of elaborately equipped laboratories. Resection of wounded intestines and anastomosis was regarded as a very dangerous undertaking and it was pointed out that the mortality following operation was much greater than when the process of repair was left to Nature's resources. As early as 1826, Denans, a surgeon of Marseilles, had described a method of effecting an end-to-end union by rings of silver or zinc in the treatment of transverse wounds, or after resection. Murphy's intestinal button was an ingenious appliance which made use of Denan's principle. His description of his animal experiments and the patients upon whom the button was used appeared in 1892. Giving full credit to the help he obtained from his associates who assisted him with the work, he placed emphasis upon the speed and efficiency with which the operation could be performed. In subsequent articles he continued to drive home these points. Two years later he reported upon its use in twenty successful cholecystenterostomies, more than twice as many operations of this type as had been recorded in the literature. He continued to write about, talk about, and accept invitations to distant cities to operate and demonstrate its indications and use. It is quite unfair to judge this method by standards of operative technique today. We must evaluate it in relation to the state of biliary tract and intestinal surgery of 1890. If we say nothing more than that by his experimental and clinical work with the button, he stimulated the skeptical to seek better ways of accomplishing the same result it will have been tribute enough. There is also something of interest in the fact that so many, from doctors to watchmakers, have directly or by innuendo suggested that they and not Murphy should have the credit for originating the button. The driving force behind an idea, and the effect it has in the field of surgery, whether it be that rarity of being an original, or the practical application of an isolated fact discovered by another, are after all the points to be evaluated.

He had continued to be an instructor in surgery at Rush Medical College until a group of physicians reorganized the College of Physicians and Surgeons in 1892. Murphy joined their forces as professor of surgery. He continued to write about the early recognition and treatment of appendicitis, biliary tract surgery, and intestinal anastomosis. Criticized as being too dogmatic in his teaching of the order of development of symptoms in appendicitis, the fact was lost sight

of that as a result of his persistent teachings cases were being diagnosed earlier and patients were getting well in the hands of the family doctor. Murphy never once forgot that the majority of doctors as well as medical students must be taught forcibly and by hammering repetitions until they are capable of recognizing exceptions for themselves.

In the late nineties Murphy had established a practice which allowed him to leave the shelter of Lee's protection. He took an office within the boundaries of Chicago's loop and devoted himself to the practice of surgery. However, Murphy never confined himself to the acceptance of surgical cases alone. He had a miserly desire for a wealth of clinical material and soon began the arrangements by which he retained control over all patients, medical or surgical, and delegated their care to others under him. His avidity for clinical medicine and patients is exemplified by his telegram in 1910 to a young colleague, then honeymooning in Europe, to proceed at once to Frankfurt and obtain some salvarsan from Ehrlich. This antedated its availability to the medical profession at large. In the same year, in the *Journal of the American Medical Association*, he reported one case treated with "606" and pointed out its remarkable properties in the treatment of syphilis. This was at a time when his strictly surgical patients were of sufficient numbers to require a large staff of assistants.

At the same time that he moved his office, the family deserted the West Side home for the South Side, sensing the ultimate decay of the neighborhood in which they lived. Again he established an experimental laboratory in the upper story of his barn. More pretentious in equipment than the room in which the button experiments were performed, it served as his workshop for many years and was described in minute detail in the leading daily newspaper.

As the result of the valuable contributions he had made to surgical progress and his spreading reputation as a gripping speaker, he was invited to deliver the Oration in Surgery at the Denver meeting of the American Medical Association, in 1898. This was the paper now recognized as a classic, entitled "Surgery of the Lung and the Nitrogen Gas Treatment of Tuberculosis." Citing the case of one of the Haymarket Riot policemen, he called attention to the dangers of a flapping mediastinum. With an extensive survey of the literature upon lung tumors, gangrene, and abscess, and with a report of his own experiments upon lobectomy, he advocated pneumothorax for the treatment of apical pulmonary tuberculosis. The idea of collapse was not new, but as in the use of the intestinal button, the Murphy method of producing collapse was stressed. The oration was scheduled upon the program for ten o'clock in the morning of Thursday, June the ninth. A note in the proceedings of the Association of the same date, "extended him a vote of thanks for his able and instructive address."

With the presentation of this paper began the long series of attacks upon him incited often by jealousy and the natural tendency of mankind to be critical of those who succeed. It must be admitted that they were fostered by Murphy's dramatic personality and his apparent lack of a desire to prevent personal publicity.

On the front page of the *Chicago Daily Tribune* of Friday, June 10, there was a two column headline, "Sudden Check to Invasion of Cuba"; "Santiago May Be Taken"; "Spain Ready to Sue for Peace." Adjoining these were other headlines: "Says He Cures Consumption"; "Quick Success in Five Cases"; "County Hospital Trials Coming." The article quoted Murphy's paper *in extenso* and was continued on the seventh page where there was a picture of the author two columns wide. Though the newspaper article did not appear before he read the oration, as has been charged, it must have been released to the newspapers. These were the days before the American Medical Association made any attempt to control the publicity of its meetings.

The effect of this publicity, considered unwarranted and an affront to the profession of Chicago, was to prevent his election to membership in the Chicago Medical Society, and more important, to the American Surgical Association for many years. Charges of running roughshod over his fellow practitioners on the West Side in his quest to develop his practice, of charging exorbitant fees, and of insisting upon a guarantee of being paid before assuming charge of a case, were linked with this display of a breach of ethical conduct. Invited to address the American Surgical Association at its meeting in New York upon the results of his intestinal surgery and knowing his name was to be considered, he accepted with the expectation that he was to be elected to membership. Whether or not he was blackballed through jealousy or lack of belief in his reports probably will never be known. At any rate, it was a humiliating experience for him. Putting into effect his often repeated dictum, "Don't ever fight back, Doctor," he continued his clinical and experimental contributions to the surgical literature. Later after having been elected a member of these societies, he read many papers before

the American Surgical Association and served as President of the Chicago Medical Society in 1904–1905.

He turned his attention from abdominal surgery briefly to publish an article in November of 1900 upon the conservative treatment of tuberculosis of the testicle. Four years previously, he had further showed his versatility as a surgeon by operating upon a patient with trigeminal neuralgia before the meeting of the Mississippi Valley Medical Association in St. Paul. His emphasis upon the important surgical pitfalls, in what was then an operation with a mortality close to 100 per cent, applies today with equal force. Later a very extensive article devoted to spinal cord and peripheral nerve surgery expressed his belief in the future of neurological surgery.

In 1902, a severe attack of pain in his left arm caused him to go to Glenwood Springs, Colorado, for a rest. It is possible that this was a forerunner of the illness which later was to prove fatal. While on this enforced vacation he read Morley's "Life of Gladstone" which impressed him greatly and was one of the few non-medical works with which he had spent any time.

He had left the University of Illinois two years before and had been chosen the professor of surgery at Northwestern University Medical School. To this position he returned with renewed vigor and enthusiasm. His Presidential address before the Chicago Surgical Society in 1903 was entitled "Tuberculosis of the Female Genitalia and Peritoneum," a contribution which has been frequently overlooked by our present day gynecologists.

A month after his induction as president of the Chicago Medical Society in October of 1904, he was in the midst of an upheaval in the ranks of Chicago medicine. On October 17, 1904, among its many advertisements for patent medicines and disreputable doctors with cures for fistulas and hæmorrhoids, the Chicago *Tribune* carried a story which stated that a decoy letter had been sent to 100 doctors in Chicago in an effort to bring to light the pernicious practice of fee-splitting among physicians. The letter purported to come from a Doctor J. C. Evans in Odell, Illinois, a struggling, young country doctor who wished to refer a wealthy patient for surgical treatment, provided he received a commission of twenty-five per cent of the patient's fee. Murphy was immediately charged with having been the originator of the plan. His reply to the doctor's letter had been in the nature of a lecture in which he vigorously attacked fee-splitting and expressed the opinion that the young man had been misguided. As he presided at his first meeting of the Society a storm of accusation from the floor broke about his head. The final reports of the Committee on Ethics were not made until the following April, when it was divulged that the Managing Editor of the newspaper had assigned a bright young reporter by the name of George Odell to carry out the plan suggested by two doctors who were sincere but misguided in their attempts to unmask the fee-splitters in the profession. The entire episode proved to be a boomerang upon the reformers, who suffered much the same fate as those virtuous husbands and deacons who complained against the practices of Henry Ward Beecher.

He had remained at Northwestern only four years, when he was called back to Rush by President Harper to become professor of surgery. Mrs. Murphy was strongly opposed to his acceptance. However, after considerable persuasion and deliberation he finally chose to return, but only upon the expressly stated condition to the President that he serve only as a co-chairman of the Department; at the same time specifying his colleague. This arrangement lasted until 1907, when he returned to the Northwestern faculty where he remained until his death.

By this time he had given up his several hospital appointments and began to concentrate his work and efforts at Mercy Hospital. It was in that hospital amphitheater, which seated many hundreds, where his reputation as a great surgical teacher was developed, and from there it spread throughout the world. He had already received honors from the University of Notre Dame, from the University of Sheffield, and from many distinguished foreign surgical societies before which he had spoken. None brought the acclaim and lasting reputation which he earned each clinic day in the old amphitheater. With senior medical students close by the pit, the visiting doctors—many from Chicago, a rare tribute indeed—filled in the background of the picture. His high-pitched voice, always a source of annoyance and worry, might be studiously subdued and lowered at the beginning, but soon he was into the subject and voice was forgotten by speaker and audience in the dramatic picture which he painted from each case. No student will ever forget the persistant, rasping, searching questions by which he brought out the facts he wished to teach. His dramatic methods struck terror into the hearts of his students but they never forgot what he taught. No member of that clinic will ever forget the lessons taught in the case of knee joint infection, followed by an arthroplasty, when he said,

"Today, gentlemen, that patient can walk." From the top rear row of the amphitheater a young man walked down the steeply inclined steps into the pit amidst a suspense of silence which few dramas ever achieve. At least one interne will never forget the morning when he read a striking and typical story of an attack of appendicitis from the blank pages of the chart of a patient whose history he had heard, but the writing of which had been precluded by his bacchanalian wanderings of the night before. After fluently describing an attack the patient had suffered, giving her past and family history, he was highly complimented. The audience was told how well he had picked out the salient features; the history was cited as an example. Then came the blow, swift and devastatingly shrill, "Doctor, turn back the pages and read again about the attack she had six months ago." His teaching was clear and logical. Starting with simple, indisputable scientific facts, he progressed toward new ideas but always along paths which were more or less familiar to his pupils. His favorite method of developing his subject by questions and answers was carried out to a great extent in his publications.

It was rare indeed that an assistant made the incision or sutured the wound. The pleasure he derived from the use of his hands was too great and the satisfaction of carrying the load alone was too much to be shared with others. This unwillingness to make his younger associates anything other than mere assistants—not sharing with them his clinical material—was to mean that he was to be eclipsed by other surgeons less able as teachers of surgery, but who created a succession of younger men who are today the heads of leading hospitals and medical schools. His attitude in this respect is difficult to explain but the records of his actions and statements in these matters are too frequent and explicit to be doubted.

On June 9, 1910, Murphy was nominated and elected president of the American Medical Association in session at St. Louis. He presided the following year in Los Angeles and was instrumental in obtaining the adoption of a resolution to the effect that any member found guilty of fee-splitting, or of giving or receiving commissions, should forfeit his membership. In his inaugural address he suggested that a series of lectures and demonstrations to the public should be a part of the annual meeting. He was strongly of the opinion that the profession had demanded of the public an acceptance on blind faith alone and that no beacon had been set to assist the layman in choosing a skillful doctor. He emphasized the importance of an annual consideration of the problem of medical education and recommended the publication of a health journal for the laity.

Murphy's tenure of office was peaceful enough but in 1913 he was chairman of the Committee on a National Department of Health. In a minority report compiled by others evidently more interested in the measure than he was, pointed criticism was leveled at the Council of Health and Public Instruction. It was developed that Murphy had allowed others to sign his name to the report. This episode was definitely to his disadvantage and added to the ammunition of those who were actively attacking his methods of practice. Finally, in 1915, he was charged with violation of the principles of medical ethics in that he caused or permitted to appear in the *Surgical Clinics of Chicago*, which were the published reports of his own clinics, photographs and an article which were self-laudatory and were contrary to the ideals of the medical profession. The Judicial Council condemned the publication as offensive and in bad taste, but accepted Murphy's defense of non-intent.

During these years he worked with that inner driving force, which was so powerful that it wore out his associates but never seemed to tell upon himself. He had gradually adopted the habit of taking a summer and winter vacation and in 1911 went to Florida for his usual March trip. There he contracted a severe case of typhoid fever, the origin of which was traced to a typhoid-carrier in a dairy near Tampa. His first attack of angina pectoris came a few months after his recovery from that illness. He was very much alarmed and was told by two Chicago physicians that undoubtedly his trouble was symptomatically angina, though there were no signs of an aortic lesion. The following year he lost sixteen pounds in weight from an obscure diarrhœa which persisted for five or six weeks. It was finally discovered to be due to the Bacillus aerogenes capsulatus and upon proper treatment the patient was cured. His anginal attacks, which had been several months apart and very mild, began to occur more frequently. It was with the greatest difficulty, however, that his wife and friends could force him to be moderate in his activities.

Shortly after the first anginal attack, the last event occurred which brought Murphy into the newspaper and before the notice of the public. While campaigning upon the Bull Moose ticket for the Presidency, Theodore Roosevelt was shot by John Schrank in Milwaukee. The force of the bullet was partially stopped by the thick manu-

script of his speech and by his glasses case. Roosevelt insisted upon fulfilling his engagement and spoke for an hour. In the meantime, word had been sent from totally independent sources to five Chicago surgeons asking them to go to Milwaukee. Among them was Murphy. They met at the station but as they prepared to leave, word came that Roosevelt intended to come to Chicago. It is said that they agreed among themselves to meet at eight o'clock the following morning and together examine the patient.

Upon the advice of a Baltimore surgeon who was present in Milwaukee, Roosevelt himself had decided definitely to make the trip to Chicago and to place himself under Murphy's care. He arrived in his private car at five o'clock in the morning and shortly after was visited by Murphy who then had him removed to Mercy Hospital and called into consultation one of his colleagues. Roosevelt's wound was treated conservatively and in the bulletins and interviews Murphy emphasized repeatedly the importance of not searching for the bullet and of watching carefully for signs of infection. During the week he was a patient, the newspapers quite correctly considered Roosevelt as front page news. The attending surgeon's bulletins and interviews were prominently featured.

This was the beginning of a mutual admiration between Roosevelt and Murphy. They exchanged several letters and visited each other on many occasions. It was also the cause for bitter charges of stealing the patient, gross impropriety in seeking newspaper publicity and flaunting professional ethics. There can be no doubt that Murphy was chosen by Roosevelt as his surgeon. That Murphy transgressed professional courtesy in not notifying his colleagues before the appointed time for their meeting, if such an understanding existed, cannot be denied. Observance of the latter courtesy to his fellow surgeons might have avoided the repetition of many variations of the true story, which by the prominence of the patient, have now almost assumed the proportion of myths. Murphy believed firmly in the view that doctors lost patients to their colleagues only because of lack of ability and skill.

He continued with his clinics on Mondays and Thursdays for his medical students and Wednesdays and Saturdays for visiting doctors. Tuesdays and Fridays were reserved, as far as possible, for visiting and dressing his patients. Morphine was never given to his patients unless he had concluded that the end was near, so that his residents had little difficulty in following his prognosis. He had become interested in the field of bone, joint, and tendon surgery and as energetically and enthusiastically pursued it as he had the surgical treatment of appendicitis. He had never overlooked an opportunity to write about the operative treatment of this latter disease. In his report upon two thousand cases of appendicitis he figuratively shook his head in amazement at the slowness with which a so called intelligent profession accepted the overwhelming force of numbers and facts in favor of an early operation.

Early in 1915, Sir Clifford Albutt's two volume work on *Diseases of the Arteries Including Angina Pectoris* was published. Murphy had confided in three physicians about his increasingly severe attacks, some of which had forced him to lie down on the operating room floor. While respecting their knowledge and views on the disease, he began to read assiduously. His copies of these volumes are full of underlined passages and marginal notes which alone give a vivid description of his own attacks and symptoms. Still he was not too self-centered, and we find his marginal comments on the origin of visceral pain and the outline of experiments to prove his points; the fact that Lee had used exercise to bring out a faint systolic murmur of the heart as early as 1883; and the importance of sudden, severe pain as a symptom of embolism in peripheral vessels. He was greatly impressed by Albutt's view that the unmistakable cases of angina are always associated with microscopic evidence of pathologic changes in the aorta and expressed the opinion that the original focus of his own infection was in his kidneys.

Attacks of vertigo became prominent and to make the situation more grave, in the winter of 1915 he had a severe nasal and pharyngeal infection. About April of 1916, there was a recurrence of this septic throat infection which confined him to bed. His anginal attacks had become terrific and were brought on by the slightest exertion. He was positive that eating breakfast brought on an attack each morning and it required a demonstration to convince him that by eating breakfast in bed he could avoid an attack. It was then only that he seemed to realize that he could not keep up his former pace.

His summer was arranged carefully with the view of obtaining a complete rest and he carried out the regulations laid down for him explicitly. In the latter days of July of 1916, it became intolerably hot in Chicago and on August 7 he left for Mackinac Island. He had lost several pounds in weight because he would not eat. The smallest mouthful of food brought on an anginal attack. He was definitely in a state of acidosis

which made the intolerable heat even more unbearable. The hotel at the Island was crowded and the only accommodation immediately available was a rather close, uncomfortable room which was vacated by the hotel clerk.

On Wednesday the ninth, he asked for a hypodermic of morphine to relieve his pain, and Mrs. Murphy for the first time realized that he was convinced that he had fought a losing battle. During a brief period of comparative comfort he dictated a request that a necropsy examination be held and then set down what he believed would be found. He was emphatic that placques would be found in his aorta and coronary arteries. He called attention to his early kidney involvement and a childhood attack of appendicitis. On August 11, he had repeated attacks and at three-thirty in the afternoon he died in the arms of two old friends, one of them his junior interne during their early days together at the Cook County Hospital.

All of the points he so carefully detailed were verified at the autopsy examination. The specter of pulmonary tuberculosis which had pursued him relentlessly throughout his early life was laid at the autopsy table. There was no evidence of pulmonary tuberculosis. So he died as dramatically as he had lived.

There can be no doubt that Murphy possessed the personality and intellect which make a great surgeon. A surgeon's reputation must rest in the final accounting upon his surgical judgment, operative skill, his ability to teach others and to inspire them to greater efforts. All of these characteristics he possessed to a great degree. His ability to present clinical surgery logically formed the keystone of this arch.

Unfortunately, the thousand-tongued power of calumny pursued Murphy throughout his professional life. Many of his actions as they stand alone, viewed from this distance and judged by our present standards, are open to criticism. He challenged the surgical world because it was his nature to do so. He was partly responsible for any suffering which these critics caused him. In contrast to a mediocre individual temperamentally disposed toward an easy and peaceful existence, he apparently craved the fiery ordeal which evoked his greatest energies. Usually, legend is kindlier and more credulous than history. This has not been so in Murphy's case because the facts which form the basis for the many legendary stories which have grown up about him are certainly more kind to his character as a surgeon and a man.

Far ahead of the majority of his contemporaries, he correlated the work of his experimental laboratory and practical surgery. Greatness in surgery may be attained by recognizing the possibilities in the work of others and utilizing them in ways never imagined by the discoverer. This gift of scientific imagination was his. The esteem in which American surgery is held abroad was due in a large part to the forceful presentation of his clinical discoveries. It is surprising how much of what it knows he taught the surgical world and this is magnified when one realizes that he made outstanding and important contributions in the fields of abdominal, thoracic, neurological, bone and joint, genito-urinary, and gynecological surgery. It is not necessary to idealize a character, bedaub it with sentimentalism or make it appear heroic, while leaving essential traits discreetly veiled to win admiration for an historical figure. Our task should be to explain and not to idolize or deify, and this should be our attitude applied to Murphy and his period in the history of surgery.

THE HIPPOCRATIC CODE AND THE NEW DEAL[1]

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OVER twenty-three hundred years ago a great thinker outlined his ideals for the practice of the healing art, and since that time the medical profession has held to this code, because the rightness of its rules for conduct has remained unshaken.

Evolution has produced countless changes in man's environment and thought during these elapsed centuries. At times these changes have been slow in forthcoming, at others, like in the present for example, rapid and disconcerting; but the principles embodied in this code, based as they are upon honorable dealing and personal morality, stand out, to Hippocrates who conceived them, as "a monument of highest rank in the history of civilization." No other profession, science, or industry has ever been organized upon a code of conduct. However, now, in the effort to revive our failing economic system, codifying every branch of human endeavor has become a national pursuit, but the medical code need not be altered for it was not reared on competitive gain. The moral debacles which have occurred in industry, public utilities, banking, and so on, have not taken place in medical practice, and will never take place as long as physicians follow the precepts of the Hippocratic code.

If we believe that many of our present day economic difficulties are, among other causes, the result of competitive overproduction—the old story of the relation of supply to demand—need we as a profession fear that the supply of health we are able to produce will ever overtop the demand? At the moment, practically the only tangible asset that anyone has is health, if he possess it, and there will always be a strong market for such wares.

The economic system which the United States has followed is that of the capitalistic, competitive, or individualistic type. While it has not worked perfectly, it has brought more relief to the masses than any other system which has been tried elsewhere in the world. But unstable conditions in industry, commerce, and so forth are tending to replace competitive effort by collective effort. While, on the one hand, the various phases of special knowledge and capital outlay in large undertakings of any kind almost necessitate collective effort for true efficiency; on the other, is the indisputable fact that real success of the collective effort is usually due to a single individual of the group. This belief is further substantiated by another fact, namely, that senescence, death, or replacement of this individual results in an impaired efficiency of the collective group.

Medicine, moving with the spirit of the times, has, in some localities, introduced team-work or group medicine, a system alike to collectivism, as a more progressive way to care for the sick. This has been responsible for radical changes occurring in the work of the individualistic general practitioner, and there is danger that he may become the forgotten man. Also, while undermining the individualistic effort of the general practitioner, this group-work has produced a more refined individualism or specialization in the practice of surgery. Even now, we may also be witnessing the passing of the general surgeon. Leaving the major divisions of the surgical specialties out of consideration, and taking thought of the general surgical services of many of our large hospitals, we find that the general surgeons in charge are more and more limiting their work to definite regions of the body—one confining his work to the abdomen, another to the neck, another to fractures, etc., etc.

Even if this overspecialization produces increased efficiency, the system which harbors it should be mindful of the truth, as well expressed by Stuart Chase that "the price of efficiency of specialization is economic insecurity." Is it wise for one so to limit his activity in a given direction that it becomes stultified in all others? To be merely a cog in the wheel of a great machine can never be the ambition of those who have raised medicine to its present high position or of those who are to carry it onward. Nevertheless, there are, today, groups desiring to make of medicine a machine powered by collectivism and under bureaucratic control. Any system which tends to lessen individual initiative can not be the one which in the end will most stimulate scientific progress. In a world continuously experiencing evolutionary and revolutionary changes, survival of the fittest is dependent upon competition, most often inspired by selfishness. The great mainspring behind human effort is selfishness. It is of biological significance, and, I question whether, if eons were spent in scientific mating of the human race in an attempt to breed out

[1]Address of the Retiring President, presented before the Clinical Congress of the American College of Surgeons Chicago October 9–13, 1933.

this quality, a superman could be developed devoid of the primal instinct of self-preservation, which is selfishness personified. With these thoughts in mind, will it ever be possible to still in the hearts of men the yearnings for personal gain?

Russia working under national planning and collectivism has been struggling to reach a goal of industrial achievement in which supply equals demand, believing that by regulating supply to demand prosperity will ensue. The workers have been given promises of prosperity, if not for themselves at least for their children. They have been willing, or have been made, to work under a stern regime for a promise which may never be but nebulous. Whenever serious doubts as to the final outcome have arisen in the minds of the more discontented, the Russian leaders have allowed a favored few to be stimulated by a mild dose of individualistic competition. In our present industrial slump are we not considering the advisability of trying to revive our competitive system by injecting a dose of collectivism?

Physicians in constantly witnessing the tragedies of illness and death are apt to develop a different viewpoint from other men. They learn early the true value of things worth while, and they are more actuated in their ministrations by a desire to help humanity than merely for pecuniary gain.

During the last 25 years the world has placed in high office the business genius, the dominant industrialist, the international banker, and in those years the general level of living of the average man has been raised to undreamed of heights. But something happened, and in the confusion necessitating economic readjustments, these past leaders became suddenly helpless. But not so with the medical profession, for it has steadily carried on with its code, and might suggest this thought to business—continue to encourage the individual in his personal efforts, for therein lies the germ of progress; and organize for common service the masses of men who are unable to provide by their own initiative, for the necessities of life. This business illness in the future will be regarded as a further evidence of continuous world progress. The leaders will take heed from this attack of industrial sickness and new health laws for business will be evolved which will become of lasting consequence toward insuring industrial security. As a nation we may be sentimental but we are also practical. We do not suddenly cast out good policies nor scrap institutions which have fulfilled a good purpose; but we are ever desirous of adding all things of proved worth, recognizing that there are values in individualism which transcend those of collectivism. These cannot be measured by any financial scale for they are not those of profit and loss but of a higher nature. They are the values of our deeper emotions, of our pride in our profession, of our cultural desires; and it would be intellectual death to relinquish them.

The present is being called an age of speed, the world awheel or in flight, with the Press announcing daily new theories for thought, conduct, and action. Unless one can talk glibly, not necessarily intelligently, about everything from feudalism to technocracy one is not abreast of the times but a back number. Each economist is pushing his own theories as if God-given, as the only way out of our present dilemma, and every industry, business, or profession is being dragged over the coals of the blazing fire of criticism and investigation. Similar furores have attended each previous cycle of depression which the world has experienced, of which there have been many, and thus far the world has survived these cycles only to emerge a better place in which to live. The medical profession has not escaped this critical review, the opportunity being supplied by the investigation of the high costs of medical care. The costs of medical care do not seem high when times are good, but when the reverse obtains, no one more than the physician can appreciate how low his compensation descends. Physicians as a class have always been referred to as poor business men, and have received little sympathy when their meager savings have vanished in unwise investments. Today the savings of the business men have disappeared in unwise investments, largely due to their failure to recognize and heed the diagnostic signs before approaching business illness became almost hopelessly incurable. However, physicians have always been concerned more with human values than with financial ones. Most medical men devote at least one-half of their entire time to the unremunerative care of the poor and only a part of their time for their own financial benefit. Perhaps the business order will think this over and adopt some such code for itself, for *sharing with others* is the corner stone of the New Deal.

A new deal follows a thorough shuffling of the pack and if politics alone were responsible for the ruffling, it would be wise to watch the shuffler for fear of stacking, for politics and sincerity are rarely partners. But, today, economic stress is shuffling with the cards face up; all are being given opportunity to assist in the arrangement of the pack, and it is the duty of all to help with con-

structive ideas so that the New Deal will win. These ideas should not be revolutionary in character but tempered with thoughtful consideration; for as the past has been full of changes so will be the future. If it were possible to bring about a millenium by a new deal, the result would probably be social stagnation from inertia. Every man who has love for humanity in his soul may long for the millenium but if it came without great changes in man's psychology, it would lack a joyous thrill. To prevent the New Deal from becoming just another deal should be uppermost in our thoughts, and the medical profession should play its hand with serious concern, decisive action, and whole hearted co-operation.

The profession is still smarting from the unjust criticism contained in the report of the "Committee on the Costs of Medical Care." This report was in short an effort to socialize medicine, to rob it of individuality, and to reduce it to the plane of a trade; a fact well brought out, fortunately, in the minority report of that committee. This effect is already apparent in those countries abroad where the system advocated has been in partial use. Against this report stands out that of "The Commission on Medical Education" which represents professional idealism and is brimful of constructive thought toward overcoming the faults of our present system.

If regimentation of the profession for better care of the sick is needed, we should plan and regulate it with the same clear thinking which has brought so many boons of modern science to humanity. The medical profession has never been so competent to treat disease as today, but, in our effort to instruct the public that there is no mystery in our art, many already believe that they are able to diagnosticate their own ills as well as to cure them by experimenting upon themselves with some well advertised nostrum. Likewise, certain groups without medical training, are trying to force their visionary thoughts as the material from which to make a new pattern for medical economics.

Every great movement requires leadership, the success or failure of which depends upon the character and wisdom of its leader. Today the future of the social systems of the world are hanging in the balance. Russia has its Stalin, Italy its Mussolini, and Germany its Hitler. Whether these systems are to be found wanting will depend upon the character of these leaders.

The temperament of the people of the United States is such that for awhile they will follow emotional drives with almost spiritual frenzy; however, as it is always wise to obey the traffic sign "Stop—Look—Listen," before dashing ahead, it is also wise to think before so doing. It has been said that men fear thought as they fear nothing else in the world. This is a way of saying that many are too lazy to think, would rather have it done for them by others, or that they are unable to follow their thinking through to a logical conclusion. The present is no moment for the medical profession to be too lazy to think, or to allow planning for medical practice of the future to be carried out by any group not trained in medicine.

It is the American College of Surgeons which must initiate leadership for surgeons. The American Medical Association, The American College of Physicians, and The American College of Surgeons are the unifying forces of the profession. These organizations must assume active control of all medical policies and determine and dominate any changes in medical practice which present or future social conditions may indicate. Then, still guided by the inspired code of Hippocrates, we must make a supreme effort, yes, call it a collective effort if you will, to preserve forever the ancient and most treasured heritage of our profession—individualism.

SURGERY, THE QUEEN OF THE ARTS[1]

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GREECE, the garden of the gods, was the temple of culture. There surgery was an art and not a science. It was gathered together and vitalized by the philosophic Axioms of Hippocrates. The Father of Medicine referred to surgery not as "an art" but as "The Art." He envisioned its nobility. He was the first to employ inductive reasoning in the sciences.

Surgery invokes all the arts as the moon summons her tides. It encompasses all the sciences. Its art is tinctured with the necromancy with which Venus, muffled in mist, kneeling in pity, applied the balm to the wound of Æneas, releasing the dart that could not be extracted. Of all the arts, surgery is the most important and the most imperative. The skilled use of the hands in the service of the brain, applied to wound and disease, is a service such as that of angels. The subtlest creation in the world is the human hand in swift confederacy with the mind, blessing both him that gives and him that receives. The arts of sculpture, painting, and portraiture are largely imitative and interpretative. The art of surgery is essentially constructive and re-creative. It is "huge in strength and wise in works."

The sculpture of Phidias has never been surpassed. Much of the accumulated arts and lovely crafts perished in the chaos of the Dark Ages. The superb coloring of the ancients in the Tyrian purple and the brilliant scarlet which fades not in centuries as well as some of the delicate tints and graceful forms which baffle the skill of the potter, have been lost. Nothing in surgery has ever been lost. Sculpture reached its final perfection twenty centuries ago. The art of surgery has increased more and more, and this has been called by Learmoth, "The Golden Age of the Craft of Surgery."

The heroic age of surgery was under the blue canopy of Italian skies. For seven centuries Italy held the primateship of the world in medicine as well as in art and culture. Galileo studied at Pisa and then forsook Hippocrates and Galen for Euclid and Archimedes. At Pavia, Bottoni taught. In the glory of the University of Bologna, with its ten thousand students, flourished its school of medicine. There Morgagni and Galvani studied. In Bologna, I saw, with a company of American surgeons, the most superb craftsmanship at the hands of our guest, Professor Putti, whom we might fittingly denominate the Michelangelo of surgery.

Fabricius regenerated anatomy. The beautiful illustrations of his dissection were said to have been painted by Titian. Under him William Harvey studied at the University of Padua. There perhaps he received the inspiration which led to his own discovery of the circulation of the blood.

In the Renaissance were those great souls—the wonder of all time—Columbus, Erasmus, Titian, Raphael, Michelangelo, Leonardo da Vinci, Cervantes, and the immortal Shakespeare. There also flourished those brilliant anatomists—Vesalius, Falloppio, Santorini, and Malpighi—and the supreme physiologist, Harvey. There was also the martyr—Savonarola. Medicine too has had its martyrs. Servetus, who discovered the pulmonary circulation, was put to death by the Calvinists not far from the dungeon turret of the Prisoner of Chillon, on the farther shore of Lake Geneva.

Of all the immortals, Leonardo da Vinci typifies most the artist and the scientist. He was more prolific of invention than any other man before Edison. In painting he delineated faces with a charm, subtle and ineffable. Who can divine the haunting, enigmatic smile of his Mona Lisa? Was her soul surprised upon her lips? His masterpiece, "The Last Supper," in its wan, shadowy beauty, has lasted half a thousand years.

He was courtier, diplomat, musician, architect, sculptor, painter, anatomist. Is it any wonder that he also encompassed literature and poetry? What a surgeon he could have been if all of his gifts and artistic touch had been concentrated upon the one almost sacred subject. As an anatomist he compels our admiration. He made over seven hundred original drawings of his dissections. They were lost for three centuries until their discovery and reproduction by the University of Oslo.

McMurrich wrote a most elaborate volume in discussion of his dissections, manuscripts, and drawings, in which he concludes that while Vesalius was undoubtedly the founder of modern anatomy, Leonardo was his forerunner, as St. John crying in the wilderness.

Petrarch said that a surgeon unlettered in anatomy carves the human body as a blind man carves wood. The knowledge of anatomy must approach that of Agnew to whom the skin of the body was as the cellophane of today. Were the skin as transparent to the great painter as it is to

[1]Inaugural address presented before the Clinical Congress of the American College of Surgeons, Chicago, October 9–13, 1933.

the anatomist, he could not paint its contours for sheer wonder and joy at the beauty, the marvel of its exquisite structure.

Art has close kinship with anatomy. Contrast the Apollo Belvedere with the Venus de Milo, the very eidolon of the female form, the Queen of the Loves; the head too small for great intellect but big enough for the greatest love. Her thorax seems built as the sanctuary of that beautiful bosom whence is destined to flow the sweet nutriment of the winged boy. Apollo's body is narrowed down to hips that might balance him on the point of an inverted cone. In the Venus, the cone is reversed, the apex above and the base at the hips. Within this broad and shallow bony temple are the sacred organs that out of nothing can evolve the wondrous work of reproduction.

Lord Moynihan, artist in surgery, sculptor of thought, and colorist of phrase, said in his magnificent Murphy oration: "The body of a man is the plastic material in which an artist works, and no art is worthy of such a medium unless it has in it something of a sacrament." To introduce an unskilled hand into such a piece of mechanism as the human body is a fearful responsibility; this was the belief of Lister and he looked upon that divinely made body as an earthly dwelling place of the Holy Spirit. No wonder the surgeon deals so gently with these wondrous tissues. It is difficult to contemplate how reluctantly he sacrifices a member of this immaculate body even for the grossest injury. Imagine the trepidation of Brashear who in Bardstown, the site of "My Old Kentucky Home," did the first successful amputation at the hip-joint, in 1806. Baron Larrey performed two hip joint amputations after the siege at Acre, but without success.

"Moses," Michelangelo's most enduring monument in the minds of men, shows majesty in the flowing beard, strength and wisdom in the mighty countenance. When the sculptor's work was completed and he gazed upon it with the rapturous joy of its creator, he said, "Speak! man, speak!" When the victim of ankylosed joints has been made free by the artisanship of remodeling the joint and intervening the satiny, fascial fabric in arthroplasties, the surgeon gently beckons to his completed work and says, "Take up thy bed and walk."

The surgeon's conception of what he wants to accomplish might be likened to Michelangelo's conception of the statue that was begging for liberation from the cold marble. The body sequesters many diseases pleading for relief, restoration, or removal. Michelangelo's sonnet exclaimed:

"Art hath her turn
And triumphs over Nature."

Ah, but to triumph over desolating disease and impending death, that is art! The surgeon may, Pygmalion-like, make his work so exquisite and perfect that the great Jehovah will touch it into life even as Venus made the marble Galatea into vibrant palpitating life.

Painters never hesitate to scrape out the work of days and begin over. It required fifteen years for Meissonier to paint that famous canvas of Napoleon "1807." Unfortunately, the surgeon cannot scrape out his work, he must do now or never, and he must do at the height of his speed and at the maximum of his skill. Blood will not wait.

Art is not alone for its beauty loved. It is a wordless poem. It challenges high contemplation. It enkindles emotion. What is more awe-inspiring than Rembrandt's painting of Aristotle before the bust of Homer? Rembrandt eclipsed all of the many predecessors and imitators by his superlative conception of "The Anatomy Lesson." The contemporary appraisal of art is often capricious. Rembrandt's vogue faded out like the shadowy figures of his background which are now his hallmark. At the end he filled a potter's grave at a cost not greater than the resurrection of the cadaver of his immortal "Anatomy Lesson." Rembrandt's mastery of shade and light, Rubens' palpitating flesh with its satiny sheen, Raphael's superb composition and serene wisdom, Titian's glowing coloring, the sweet joyousness of Correggio, and Michelangelo's impassioned and imperishable work, were the greatest expressions of Renaissance art.

What makes the art of the surgeon? Perhaps it is embodied in Cutler's tribute to Cushing, the master surgeon, when he says: "His technical performance, his craftsmanship have permitted him each day to create with his hands works of real beauty . . . an example of how practice of the art begets the science." The surgeon must, with fingers that are dexterous beyond compare and with mind that plans, see the completed result in his imagination. He models and commands the method, carries out the procedure, puts the parts into perfect apposition, and God knits the scar. He sews severed arteries that they may carry their crimson torrent without leak and without hindrance. When a surgical operation is described as beautiful, it seems incongruous and uncanny to the average layman. To one who can appreciate its beauties it is really the acme of artistic perfection.

A resection of the stomach by a master like Mayo, widely excising the diseased part, restoring continuity and function, all so deftly and beautiful in its beneficent invasion and conquest, is a magnificent epitome of the surgical art. "Uneasy lies the head that wears a crown," but only the surgeon knows how uneasy lies the head that wields the knife! It requires such intrepidity, unreckoned clairvoyance.

The surgeon is twice educated. Biochemistry and the processes of disease are infinitely more complicated and elaborate than all the sought for transmutations of the alchemists. Pathological conditions, unrelenting, protean, are his daily, deadly, life-long enemies. He must have something of the seer, of the soothsayer, of the warrior in combat, of the commander in conflict. After all, he must not only possess knowledge, and Science, he must be an artisan of the highest degree. He must acquire a complete handcraftsmanship. He must develop artistry to perfect his magical ministrations. The gift of imagination ever beckons the surgeon to the extension of his realm and to the augmentation of his field of usefulness.

The art of surgery is associated in the most intimate way with the ancillary sciences of anatomy, physiology, pathology, bacteriology, and biochemistry. Electricity has begotten a beautiful art of its own—roentgenology which has made the body translucent.

Surgery has been ennobled by many great artists and many great souls. We see Ambroise Paré brushing out the shop of his barber father at cockcrow, and then an apprentice at the Hotel Dieu. Thus out of the mouths of barbers and cutters did surgery breathe its message to Paré. He first used the ligature instead of the hot irons to stop hæmorrhage, at the siege of Damvielliere (1552). A new era was inaugurated by an inventive genius, masterly man, and one of the prelates in the priesthood of surgery.

John Hunter, unequalled by all the surgeons before him! To his inquiring mind all living tissue was of transcendent interest. His distinguished brother, William, "bred him to anatomy." He dissected out the arterial system and the lymphatics. Amazing industry in pathology, comparative anatomy, and biology made him the first to correlate these sciences with surgery and to become the veritable founder of modern scientific surgery.

The shield of the Royal College of Surgeons of England bears the medallion of John Hunter flanked by the two famous sons of Æsculapius, Machaon, and Podalirius. One healed injuries; the other could recognize what was not visible to the eye and tended what could not be healed. The surgeon has ever combined this dual ministry.

From Long and Morton came anæsthesia, that great discovery which overleaps the limit of audacity and invokes the similitude of death to annul the agony of surgery. It gave a balm richer than Nepenthe, for anæsthesia conquers all pains and calms all terrors.

In the elder day, surgeons had to work at breathless speed. Amputation was performed with two thrusts of the catlin, the swift passage of the saw; the member fell in an incredibly few moments, with a conjurer's rapidity. So indescribable was the agony that the surgeon needs be stout hearted, and his art exhibit the swiftness of the wind. In those violent days, we trust, men's nerves were mercifully blunted. Wurtz in an apostrophe to conservatism said, "Never, if you can help it, bereave a man of any part; for God's grace may be great upon it beyond the expectation of men." Celsus, who lived in the turbulent times of Tiberius, stressed adroitness and ambidexterity as a prerequisite of the art of surgery. He demanded likewise that a surgeon should be without pity. That was essential in pre-anæsthetic periods. The abysmal medievalism had the notion that surgery was antagonistic to the finer feelings of the savant. Now the flower of modern scholarship is found engaged in its beneficent solace.

Medicine was regenerated in the nineteenth century by the surgeons of England. When sepsis, the maternal analogue of sin, stalked up and down the haunts of men, the science of Pasteur and the art of Lister came as the Redeemer came. It was by absolute asepsis that surgery was exalted to a plane in unbroken continuity with morality and religion. Antisepsis caused a greater revolution in the art of surgery than all the civil revolutions that ever thundered through the annals of time.

Pasteur has been described as the most perfect man who has ever entered the Kingdom of Science. His transcendent discoveries were bitterly denied by his countrymen. It remained for Joseph Lister, with marvelous insight, to see the application of Pasteur's principle to the suppuration of wounds. Velpeau hopelessly lamented that "A pin break is a door open to death." The reason Pasteur's discoveries of the new world of micro-organisms was appreciated first by Lister was, in Sir Sifford Allbutt's fine phrase, "because he was watching on the height, and he was watching there alone." Lord Moynihan said of Lord

Lister, the Prince of Surgeons of all time, "He has been the means of saving more lives than all the wars of all the ages have thrown away."

So tragic was the incidence of infection, hospital gangrene, erysipelas, and so great was the risk of sepsis after every operation, that Sir James Simpson exclaimed, "The man lying on the operating table in one of our surgical hospitals is exposed to more chances of death than the English soldier on the fields of Waterloo."

You are familiar with the evolution of modern asepsis, first insisted upon by von Bergmann and perfected by each of the nations' toilers in the art of surgery, until it reached its present perfection.

In America the battles of aseptic and artistic surgery have been fought and won.

Surgery is comparable to the fine arts because of its beauty, its benison, and its artistry.

Witness the formal invasion of the brain. It is at once the most highly technical, and artistic creation that surgeons have evolved. It requires the highest endowment. The demand is imperative but most forbidding in its inherent danger. The extirpation of a tumor of the cerebellopontile angle is a supreme achievement. The finesse of details, the perfection of hæmostasis, anæsthesia, position, approach, is superlative. The actual enucleation is far and away the most delicate imaginable procedure and tests the fitness of a finished brain surgeon to its utmost. In the invasion of the brain, it is as though the soul were poised ready for flight but hoping for continued residence awaits the verdict, measured by the skillful feat of the operator.

The heart is only 2 inches from the surface, yet it took two thousand years for the scalpel of the surgeon to travel that distance. When Goethe said, "A wounded heart can, with difficulty, be cured," he was speaking figuratively. A real wound of the heart can be cured. The chest wall is quickly opened. The sac is filled with blood clots and its feeble flickering beats, all but extinct. The surgeon plugs the aperture with his thumb while the heart flutters in his encircling hand, the rent is sewn up as its ruby drops pour out. There is not time to think, there is only to do or let die. When the precious ebbing flow is staunched by accurately placed sutures, the accomplishment is the pinnacle of art.

Matas boldly opened the walls of an aneurismal sac and re-created an artery by infolding its redundant walls. Is it not the personification of art to make a new conduit from which blood will not leak from a tortuous and distended arterial sac with numerous openings with the artistry of a needle and thread? What art can the engineer bring to bear to keep the Father of Rivers within its overflowing banks and stop the flood?

What more perfect mechanical device than the art of John B. Murphy, supersurgeon, produced when he invented the Murphy button? It made intestinal anastomosis exact and led to the artistic perfection of the suture methods.

Transfusion, so long desired, is the last rite in the ritual of salvation. The exsanguinated victim of injury or disease, who is sicklied over with the wanness and pallor of death, by the now simple art of transfusion is brought back to the pinkness of returning life and soon to the smiling realization of his blessed reprieve. It is like the magic of the gods.

The anatomical limitations, the gravity of the pathological conditions in the chest, particularly tumors, make invasion of the chamber one of the most delicate and yet bold efforts of our field. Therein life flutters and the flame of its candle seems fitfully burning and easily extinguished.

Surgery has given its greatest endeavors to woman—the cæsarean section for her unbornable child. McDowell invoked the bold invasion of the abdominal cavity for the removal of the great new-growths that made for women untimely graves. This presaged all of the marvelous surgery of the peritoneal interior. It is vision commanded by courage that sails into the domain of curative surgery. The art and genius of J. Marion Sims with the silver wire suture made lacerated woman whole. The victim of vesicovaginal fistula is no longer a prisoner in her own house. She is rescued from her wretchedness by the most delicate skill and the gentlest artisanship.

In the year of the speaker's birth, his father's professor of surgery, the elder Gross, the Nestor of American surgeons of his day, said: "When the tumor (goiter) is large the wound is of frightful extent. It (the operation) is equally deserving of discouragement, if not positive rebuke and condemnation." Now the alleviation of this unsightly and insidious malady is the daily satisfaction of many surgeons. It is regularly done in skillful hands with a mortality of less than one per cent. The technique of the extirpation of a goitrous gland has been freely taught by the masters, Mayo and Crile, and may God spare them in the Fellowship of the American College of Surgeons.

In the other fine arts, art is justified for the sake of art. In surgery it is a real need because upon the finesse and perfection of its artistry, the success of a surgical procedure largely and sometimes entirely depends. It is the art of the sculptor

rendered with the heroism and skill of a life-saver.

Look back upon the pageant of the noble figures who have adorned the art of surgery, now with thinned ranks, now with platoons of eager, exultant marchers. Our art is illumined in the arsenals of history by an unbroken chain of inspired workers, captained by the occasional heaven-endowed genius, imbued with great purpose. From all climes they come to form the solidarity of surgery, the pride of all the world. Thus Art and Science walk hand in hand led by Apollo and the Muses to Olympian heights.

Surgery, thou art the Queen of the Arts!

SURGEON OF THE WILDERNESS—EPHRAIM McDOWELL[1]

WILLIAM D. HAGGARD, M.D., F.A.C.S., D.C.L., NASHVILLE, TENNESSEE

IN a backwoods settlement in the wilderness, now the famed center of Kentucky's unrivaled blue-grass beauty, there was enacted a surgical drama of transcendent import. It was the first ovariotomy in the history of mankind and was performed by Ephraim McDowell. How did it happen? Let his original publication describe the *mise en scene:*

THREE CASES OF EXTIRPATION OF DISEASED OVARIA

By Ephraim McDowell, M.D. of Danville, Kentucky.

In December, 1809, I was called to see a Mrs. Crawford, who had for several months thought herself pregnant. She was affected with pains similar to labour pains, from which she could find no relief. So strong was the presumption of her being in the last stage of pregnancy, that two physicians, who were consulted on her case, requested my aid in delivering her. The abdomen was considerably enlarged, and had the appearance of pregnancy, though the inclination of the tumor was to one side, admitting of an easy removal to the other. Upon examination, *per vaginam*, I found nothing in the uterus; which induced the conclusion that it must be an enlarged ovarium. Having never seen so large a substance extracted, nor heard of an attempt, or success attending any operation, such as this required, I gave to the unhappy woman information of her dangerous situation. She appeared willing to undergo an experiment, which I promised to perform if she would come to Danville (the town where I live), a distance of sixty miles from her place of residence. This appeared almost impracticable by any, even the most favourable conveyance, though she performed the journey in a few days on horseback.

What manner of man was he to propose to do this wondrous thing? Who was this angel of light? Whence came he? Who were his forebears?

McDowell's ancestors were the sturdy Scotch presbyters who emigrated from Argyle to the north of Ireland during Cromwell's Protectorate. The great grandfather Ephraim for whom the illustrious surgeon was named, showing his origin from the Covenanters, fought with them against Charles I in the English Rebellion, and later immigrated to Pennsylvania. Thence his grandfather moved to the Shenandoah Valley near the historic town of Lexington. Rockbridge County, Virginia, west of the Alleghanies, was a vital part of Virginia's strength in the Revolutionary War and in the unfortunate Civil War. There the great grandfather, Ephraim, was buried after rounding out a century. His grandfather was ambuscaded by the Indians on a Christmas day. His father fought in the French and Indian wars and was a colonel in the Revolution, his regiment seeing service in the campaign against Cornwallis. In the convention at Williamsburg he was one of a group who memorialized Congress to declare independence. Over the Wilderness Road across the mountains, this patriot and forebear came to the district of Kentucky and served as a judge in the first court when it was removed to Danville and was in Kentucky's first constitutional convention.

Kentucky is a child of Virginia. Pioneers under George Rogers Clark, parties of hunters, and company agents, and settlers moved through the Cumberland Gap, which was found in 1750 at the present junction of Virginia, Tennessee, and Kentucky. It was the trail the Cherokees and Shawnees had made leading northward, called The Wilderness Trail. Along this path the race for the exploitation of the New Canaan took place. They trekked west to satisfy land hunger and the indomitable spirit of pioneering. Daniel Boone preceded the McDowells by fourteen years in his first visit of exploration to Kentucky.

This earlier colony of Transylvania was called Kentucky, which means meadow land from "Kentake" in the Iroquois language and was so named in the blessed year of our Declaration of Independence. Over half a century after the Revolutionary War, there were nearly a thousand veterans still living who in their adventurous spirit had immigrated to Kentucky. These early settlers, at a distance of nearly a thousand miles from the capitol in Richmond by way of the famous Wilderness Road, succeeded in having Kentucky separated from Virginia and admitted into the Union in 1792, nine years after the McDowell migration. This wilderness settled by intrepid spirits was really the "Dark and Bloody Ground." The depredations of the Indians made constant warfare. The highest type of courage was essential to the safety of these fearless people. It was the "Wild West" of that day. While it nestled against the Alleghanies on the east, its fathomless extension to the unknown west constituted that ever advancing and beckoning frontier which gave to America the opulence of the Golden West, and to history the most picturesque frontiersman the world has ever known.

Ephraim McDowell was born in Rockbridge County, Virginia, in 1771, on November 11. This was an armistice day against woman's thraldom from ovarian cysts. This child was to write a treaty—The Surgical Treaty of the Wilderness. This Virginian, born under the British flag, was

[1]Presidential Address, presented before the Convocation of the American College of Surgeons, Chicago, October 13, 1933.

five years of age when the War of Independence started and thirteen years old when he was brought into that heroic land that he was to make sacred as the birthplace of a great contribution to humanity. He was not the seventh son but the sixth son of eleven brothers and sisters.

The founder of the little town of Danville was killed by the Indians, but it became the first capital of the state of Kentucky. Lord Dorchester, writing back to England a few years after the McDowells established their residence, said the town had a hundred and fifty inhabitants whereas its sister city, Lexington, had about six times that many. Perhaps this is the reason why the Transylvania Seminary was moved there from Danville to become the first university in the west and the second medical school in the United States. Thirty years afterward, with McDowell as one of its incorporators, Center College was established.

At the age of nineteen he went "to read medicine" under his preceptor, Dr. Alexander Humphreys of Staunton, who was a graduate of the University of Edinburgh, then the greatest of the European schools. The system of the preceptor is no more. Now the crowded curriculum and supposedly superior advantages of an exclusive intramural training has done away with that inspiring example. May we not be losing something in giving up the wise precepts, the sagacity of observation, the resourcefulness, the tact, and the gentle tenderness of those worthies?

Immediately after his tutelage with his preceptor, McDowell went to Edinburgh. He remained there during 1793–4 but did not take a degree. He was accompanied by Samuel Brown who became an accomplished physician, one of the first teachers in Transylvania University. Among his students was the brilliant Benjamin W. Dudley, who became the greatest lithotomist of his time. David Hosack, whose memory is commemorated by the Academy of Medicine in New York, was also a student-companion of McDowell. He was a friend of Alexander Hamilton and acted as one of his seconds in the famous duel with Aaron Burr. Although a student under the second Monroe in Edinburgh, it appears that of his extramural teachers of surgery, the brilliant and eloquent John Bell was the most inspiring. He was a great anatomist and wrote works on anatomy and surgery. John Bell was a stormy petrel and was not in sympathy with many of the rigid customs and nepotism of the University. He had his own dissecting room and museum in a building on Surgeons' Square. Worshiped by his students, he was in constant controversy with his colleagues. Much of his work was done in collaboration with his distinguished younger brother, Sir Charles Bell, who was the first to discover the function of the anterior and posterior root of the spinal nerves and to distinguish them.

McDowell began his practice at Danville in 1795, and soon became the premier surgeon west of the Alleghanies. He performed all the operations then known to surgery from an amputation to a tracheotomy. He operated repeatedly for strangulated hernia and was a skilled lithotomist. There is evidence also to believe that McDowell resected the parotid gland, thus long antedating McClellan and other American surgeons.

Before the days of stagecoaches, he made many visits within a range of one hundred miles or more through the trails of the forest alive with hostile Indians, the timber wolf, and the howl of the panther. Some of these journeys required a week or more. While Andrew Jackson, in 1812, with his Tennessee riflemen vanquished Pakenham from behind the cotton bales at New Orleans, another future president of these United States, James K. Polk, a callow youth of nineteen, journeyed on horseback to Danville from his home in Columbia, Tennessee, which the poet, John Trotwood Moore, has denominated "the dimple of the universe." McDowell removed a stone from the bladder of the future eleventh president. He did altogether thirty-two lithotomies without a death. He abandoned the lateral operation with the gorget and did the central perineal lithotomy, as we do today, thus differing from the other famous lithotomists of the South—Dudley, Briggs, and Eve. Most of his operations were performed on Sunday because it was the most quiet and the day on which he had the most leisure.

Of the first ovariotomy, let the valiant surgeon give his own brief description in this extract under the heading,

THREE CASES OF EXTIRPATION OF DISEASED OVARIA

I made an incision about three inches from the musculus rectus abdominis, on the left side, continuing the same nine inches in length, parallel with the fibres of the above named muscle, extending into the cavity of the abdomen, the parietes of which were a good deal contused, which we ascribed to the resting of the tumor on the horn of the saddle during her journey. The tumor then appeared full in view, but was so large that we could not take it away entire. We put a strong ligature around the fallopian tube near to the uterus; we then cut open the tumor, which was the ovarium and fimbrious part of the fallopian tube very much enlarged. We took out fifteen pounds of a dirty, gelatinous looking substance. After which we cut through the fallopian tube, and extracted the sack, which weighed seven pounds and one-half. As soon as the external opening was made, the intestines rushed out upon the

table; and so completely was the abdomen filled by the tumor, that they could not be replaced during the operation, which was terminated in about twenty-five minutes. We then turned her upon her left side, so as to permit the blood to escape; after which, we closed the external opening with the interrupted suture, leaving out, at the lower end of the incision, the ligature which surrounded the fallopian tube. Between every two stitches we put a strip of adhesive plaster, which, by keeping the parts in contact, hastened the healing of the incision. We then applied the usual dressings, put her to bed, and prescribed a strict observance of the antiphlogistic regimen. In five days I visited her, and much to my astonishment found her engaged in making up her bed. I gave her particular caution for the future; and in twenty-five days, she returned home as she came, in good health, which she continues to enjoy.

During the exultant heroism of war, with flying flags and clarion's call, with flaming patriotism, one can understand the bravery of the soldier. But to essay the unknown without the urge of battle-call requires much more courage than to lead the valiant charge. As the result of this epoch-making event, now no hamlet is without an example of one who has received the benefit of a surgical procedure within the confines of the abdominal cavity. The confidence with which this and many other abdominal operations are performed today is vastly different to this unknown and untried experiment. There was no anæsthesia, no precedence, no hospital, no trained assistants: the doubt of the patient's recovery, all made it a marvelous undertaking.

The lethal tendencies of ovarian tumors had been only too well realized. Their fatal result in a few years was inevitable. Many, many women were tapped for mere temporary amelioration of their unrelievable burden. It had to be repeated again and again. One case reported by Penrose had 299 tappings, which removed a total of 9,867 pounds.

The anatomy and pathology of these growths were understood; many autopsies had been performed; and while this had been within the conception of man it was believed to be incompatible with life. In McDowell's brain there was the dormant thought that had been given by his inspirational teacher, John Bell, who had by careful postmortem examination shown the physical feasibility; but it was like the gunpowder, it required the spark. McDowell was the lightning-forged spark.

Was this man heaven-endowed? We acclaim him a bold, intrepid genius who had all the preparation and the grim courage to put to the test the possibility of what he dreamed.

A hundred years before, William Hunter, the anatomist and obstetrician, taught that excision can hardly be attempted. John Hunter, the surgeon and man of vision, said, in 1785, "I cannot see any reason why, when the disease can be ascertained in an early stage, we should not make an opening into the abdomen and extract the cyst itself" and "Why should not a woman suffer spaying without danger as well as animals do?"

It was estimated by Peaslee that in the thirty years prior to his analysis of all ovariotomies in 1870, that thirty thousand years had been added to the lives of those women who had undergone the operation, to say nothing of the thousand years of untold agony that they would have collectively endured.

Koeberle of Strasbourg who invented the piano wire ligature under metal skewers in the extraperitoneal treatment of the pedicle of a fibroid tumor, said of ovariotomy: "It was an operation without a parallel, and an operation that was fraught with happiness. . . . It was one of the most convincing titles to glory of our surgical epoch."

The fact that McDowell lived in the wilderness and has been referred to as a backwoods surgeon, perhaps was a blessing. It gave him those indomitable characteristics of courage which strife with the Indian tribes begot in those tense times. Quick decision and instant action were imperative. He was unriveted from the domination of universities, from the mandate of seniors, from the precedence of colleagues. He was an independent spirit. It is not an accident that this greatest of surgical dramas was enacted in the pure natural surroundings of God's frontier. Witness the greatest medical evolution of our own age which has transpired in a small town of the great upper middle west.

What better training could McDowell have had than a European background projected into the valorous life of those burgeoning times. The fact that he was a Surgeon of the Wilderness gave him the courage to carry out the operation. The absence of sepsis was due to the cleanly condition of the open country and the absence of large numbers of suppurating wounds menacing all new made wounds. We find the exact setting, a man who believed in himself and who had vision, a woman brave enough to follow her necessitous intuition. The open-mindedness of McDowell and the heroism of Jane Todd Crawford were the needed twain. But for them the operation of ovariotomy might have been postponed a half hundred years. It is recounted by her grandson that during the terrible ordeal she repeated the Psalms, and we can well imagine that it was the beloved Psalm of David, "Yea, though I walk through the valley of the shadow of death, . . . "

The great granddaughter of the woman whose bravery made the feat possible said that Jane Todd Crawford and Mary Todd Lincoln, the wife of President Lincoln, were both descended from two brothers Todd who settled in Pennsylvania. She lived to be seventy-eight years of age, having survived the operation more than thirty-two years.

McDowell has been criticized for not reporting his work earlier. He waited seven years. Meanwhile he performed two other ovariotomies. He sent his report to Dr. Phillip Syng Physick, the leading surgeon of Philadelphia, who was called the Father of American Surgery. He had been an assistant to John Hunter. All his life he retained his queue. He was engaged in all the arduous duties of teaching medicine, was introspective, and really a sick man. He did not publish his own work and did not give much consideration to McDowell's report. Dr. James McDowell, his nephew, then finally presented it to the editor of the *Eclectic Repertory and Analytical Review*. It saw the light of published day from the consideration of Doctor James, the editor, who was professor of midwifery in the University of Pennsylvania. Both Physick and James had left Edinburgh just a year before McDowell matriculated.

A duplicate copy of his report he forwarded to his old master, John Bell, who on account of his health was in the south of France. He died in Rome without hearing of the momentous exploit of his blessed disciple. It fell into the hands of Mr. Lizars who was looking after the work of his absent chief. There it reposited for another seven years, until Mr. Lizars had essayed the operation himself. He reported his work in a beautiful monograph and published in connection therewith the three cases of McDowell in the *Edinburgh Medical Journal* for October, 1824. Mr. Lizars had performed three operations, one patient recovered, one died, and in another the operation was for the mistaken diagnosis of phantom tumor. McDowell's three successful cases were thus brought sharply to the attention of the large part of the English profession.

McDowell was most scathingly and sarcastically criticized. The *Medico-Chirurgical Review* of January, 1825, said editorially: "In despite of all that has been written respecting this cruel operation, we entirely disbelieve that it has ever been performed with success, nor do we think it ever will."

Like many prophets, he was doubted, especially in his own country. His critics were at times libelous. The criticism was so extreme that he indited a card to "The Physicians and Surgeons of the West, and particularly to the Medical Faculty and Class at Lexington" and stoutly defended his operation which had been challenged.

He said, "Although the termination of this case was most flattering, yet I was more ready to attribute it to accident than to any skill or judgment of my own, but it emboldened me to undertake similar cases, and not until I had operated three times, all of which were successful, did I publish anything on the subject." When, however, the accuracy and truth of the accomplishment had been made known the London editor said, "A back-settlement of America—Kentucky—has beaten the Mother Country, nay Europe itself, with all the boasted surgeons thereof, in the fearful and formidable operation of gastrotomy with extraction of diseased ovaria. . . . There were circumstances in the narrative of the first three cases that raised misgivings in our minds, for which uncharitableness we ask pardon of God and of Doctor McDowell of Danville."

McDowell made a second report in September, 1819, in the form of a letter to Doctor James, the editor of the *Eclectic Repertory*, entitled "Observations on Diseased Ovaria." He reported also two additional operations. One in April of 1817 in which the cord, which he had firmly tied around the ligament attached to the uterus before cutting away the tumor, slipped off owing to the "shortness and sponginess of the part" and a profuse discharge of blood occurred. He religatured the pedicle but without satisfactory results. He then armed a needle with a strong ligature and passed it around the ligament and secured it in its place by several sutures firmly tied, with a recovery. The tumor weighed five pounds. Thus a new, and now old, method in transfixation of abdominal pedicles was first employed.

In 1822 he rode from the blue-grass region of Kentucky to its replica in the blue-grass bowl of the middle basin of Tennessee. He went to operate upon Mrs. Overton for an ovarian tumor. She was a very corpulent woman, the wife of General Thomas Overton, friend and neighbor of General Andrew Jackson and his comrade in arms in the Creek War.

During the ovariotomy upon Mrs. Overton, her neighbor, General Jackson, is said to have held her hand and otherwise supported her fortitude. McDowell visited General Jackson at the Hermitage, fourteen miles from Nashville, and at his request operated upon a negro slave, removing a very large tumor from his neck.

Upon the presentation of the check which General Overton gave him at the little bank on the public square, the cashier presented him with

a sum far in excess of his fee. McDowell thinking there was some error, sent a horseman to the vicinity of the Hermitage. He came back with the message that there was no mistake and General Overton only regretted that he did not have more to pay for the great service which had been rendered his wife. This generous measure of appreciation is only occasionally encountered in Nashville today. Gross said this was the largest fee ever paid in this country for a surgical operation, and under all the circumstances comparable to the fee of one thousand guineas paid by the Indian merchant to Sir Astley Cooper.

Mrs. Overton, who was operated on at the age of fifty-five years, lived to be seventy-seven and her tomb is now at the site of the great DuPont Powder Plant, which was erected during the World War.

McDowell performed ovariotomy thirteen times with eight recoveries, four deaths, and one case was uncompleted.

And what of the personality of this great-hearted man?

He was adjudged handsome with lustrous black eyes. He was nearly six feet tall, rather florid, somewhat inclined to corpulency. He could upon occasions play his violin. While our profession are often unable to cultivate the Muses, I remember hearing von Mikulicz and Maurice Richardson play a Beethoven sonata, in the home of W. J. Mayo, himself a great lover of music. A temperate man, he occasionally indulged in a sup of cherry bounce—a celestial cordial. In literature he preferred his fellow-countrymen—Scott and Burns. He was the fastest foot racer in the University and the Edinburgh paper said, "He has a superb physique, lithe, and of almost Herculean strength." He was one of the kindest-hearted and most amiable men, overflowing with cheerfulness and good humor. He married the daughter of Kentucky's first and greatest Governor—Isaac Shelby.

He died in 1830 and in the fifty-ninth year of his age. The records are not at all satisfactory but it seems he had a severe, acute, painful abdomen with nausea, vomiting, and fever that was fatal within two weeks. As a result of his own labors it has been vouchsafed to surgeons to combat acute catastrophies of the abdomen from which he died.

In 1823 the University of Maryland had conferred upon him the honorary degree of Doctor of Medicine.

In 1879 the Kentucky State Medical Society erected a monument of enduring granite to his memory and a notable oration was delivered by the Nestor of American Surgery—Samuel D. Gross. In presenting a memento to Doctor Gross on that occasion, Cowling said, "When history shall recall his deeds and dwell upon his memory, it will relate how, when he was fifty years at rest, the greatest of living surgeons in America came upon a pilgrimage of a thousand miles to deliver a noble oration." As the most intimate memento, the door-knocker of McDowell's house was chosen. The presenter said, "It will tell of many summonses upon mercy's mission which did not sound in vain. Ofttimes has it roused to action one whose deeds have filled the world with fame."

One of his biographers, Schachner, to whom I am indebted for many facts, said, "Ovariotomy placed in the diadem of the art and science of surgery its most brilliant gem and in the æon of time becomes the indirect emancipator of countless millions of human beings from protracted suffering and premature death."

May we say with Gross of this immortal soul who has done for surgery what civilization has done for the wilderness, "All honor to the man who had the courage and skill to do that which no man had ever dared do before."

The unexampled achievement of the Surgeon of the Wilderness, Ephraim McDowell, "like the widening waves of the inviolate sea, shall reach the uttermost shores of time."

BACK TO GALEN[1]

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MY brief remarks this evening are entitled "Back to Galen." Their purpose, however presumptuous they may sound, is not to tell you anything you do not know, but to remind you of some things which in the busy and lucrative practice of your profession you may sometimes forget. This is all the easier for me because, as the Departments of Surgery at The University of Chicago will tell you, I know nothing whatever about your profession, and have so far preserved my figure intact from any association with your admirable but uncomfortable investigations. Since by definition a classic is a book that nobody reads, I feel all the more free to base my discussion on Galen. Where he does not agree with me, I shall suppress the fact, in the hope that you will not be aware of it.

Galen was the summary of Greek medicine. He had that faith in the beneficent operation of nature which was the slogan of Hippocrates. But the anatomists had shown him things Hippocrates never knew. He rested his argument on clinical observation. He proclaimed the value of experiment. In these respects he was completely modern. He attacked the Atomists, who broke the body down into parts and looked at them alone. They wanted the practitioner to believe that the sole object of attention when a leg was fractured was the fractured leg. He attacked the Methodists, who conceived of diseases as independent entities unrelated to anything. Here, as Brock has said, "What Galen combated was the tendency . . . to reduce medicine to the science of finding a label for each patient, and then treating not the patient, but the label."

The central idea which Galen entertained was that the organism is a whole. As such it cannot be further divided. The whole is not the sum of the parts. An organism is just that, nothing more nor less. The organism is a whole with an environment. It cannot be considered apart from that environment. Knowledge of the environment is, therefore, as important as knowledge of the organism. Knowledge of the organism as living is more important than knowledge of it as body. And knowledge of the whole organism living in its environment is more important than the most intimate familiarity with all its parts. I think you will agree that in respect of this central idea Galen can hardly be called modern at all.

And yet I venture to suggest that it is to the least modern aspects of Galen's thought that a return is most desirable. We need not fear that medicine will underestimate the importance of clinical observation or experiment. The outstanding achievements in these fields are the proudest boast of the profession. But we still have our Methodists, who treat the label instead of the patient. We still have our Atomists, who believe that mere collection of minute facts about parts will in some mysterious way add up to a solution of the problems of the whole. The results of this denial of Galen's principal idea are of some importance to medicine, education, and the public.

The first of these consequences is vicious specialization. For a corollary of forgetting Galen is to assert that understanding depends upon analysis. No one will deny that it may. But the whole theoretical foundation of exclusive insistence on this attitude has now been swept away. Such insistence rested on physical doctrines of space and matter which incited investigators to look at little bits of matter, and the smaller the bits the better. It is possible in this view to examine one bit without any relation to any other bit except perhaps a relation in space. This notion modern physics has now discarded. Its leading concept is that of a unified world in which there is no such thing as an isolated object or organism. Every dislocation anywhere produces another dislocation somewhere. Every organism is constantly modifying its environment and being modified by it. The theoretical basis of raw empiricism is gone.

We may be permitted to doubt whether raw empiricism can be the foundation of science. We may refer with profit to the words which Claude Bernard kept repeating again and again. "By simply noting facts," he said, "we can never succeed in establishing a science. Pile up facts and observations as we may, we shall be none the wiser." And once more, "Endless accumulation of observations leads nowhere."

Failure to respect this axiom has produced confusion, and not in the natural sciences alone. The current desire to be scientific has led social scientists and even humanists to imitate what they conceive to be the method of natural science. Some of my friends in social fields seem to think that by collecting data on cards and continuing the process until all available space in the Univer-

[1]Fellowship address presented before the Convocation of the American College of Surgeons, Chicago, October 13, 1933.

sity is filled with them, all social problems will be solved. To most medical men this view will no doubt seem archaic. In medicine there is a demand for understanding based on synthesis as well as analysis. We see the fruits of this demand most obviously in the theory of the glands of internal secretion and in modern neurological doctrine. Nevertheless we may sometimes feel that the wealth and prominence of a surgeon may depend on the degree to which he has succeeded in forgetting he is dealing with a whole body, a whole person, a living organism in its environment.

This attitude has had a disastrous effect on the study of problems of personality. Insistence upon empirical analysis led medical men for a time to ignore these problems, because there was no empirical method of investigating them. At length, however, the belief that anything that had to do with health fell within the province of medicine, together with the assumption that medical problems must be tackled atomistically, produced first, resentment against the attempts of other groups to deal with these matters; second, failure to co-operate with scholars in other fields having to do with organisms and their environment; and finally, efforts to solve problems of personality by such methods as the minute anatomy of the brain.

The family doctor at his best understood the organism as a whole. His disappearance under a wave of specialization has thrown the public into the arms of one cult after another. The modern clinic is a strenuous effort to re-incarnate the general practitioner in corporate form. Here a group of specialists, frequently with an attachment of social workers, try to capture and pool knowledge of the organism in its environment. The effort is admirable, and has great accomplishments to its credit. Yet because of the cursory acquaintance that can at best be achieved and because of the difficulties of constructing a composite picture of an individual, we may feel that even here the sum of the parts will not quite equal the whole.

Then, too, raw empiricism in medicine has impeded other attacks on problems of personality, such as psychoanalysis, which provides at once a theory of personality and a method of investigating psychological processes. Whatever we may think of psychoanalysis, we must admit that it was, in its inception, an honest attempt to understand the organism as a whole. Those things in its later history of which we may disapprove have resulted as much from deliberate or ignorant misconception of its purposes as from any inherent weaknesses in its theory. Psychoanalysis standing alone is certainly not the answer to all problems of personality. But any solution of them must begin from the same starting point, the one which Galen has given us.

The educational consequences of forgetting Galen are no less serious. I pass over the question of lay education in medicine, where we may simply note that the public has become hysterical in matters of health, and manifests neurotic symptoms in response to the slightest impact of journalistic information. Instead I would point out that all education and not medical education alone has suffered from overlooking the lesson that Galen might teach it. We have witnessed a shift of emphasis throughout education from thought to information, from idea to fact. The president of one of our greatest universities said a little while ago that it would soon be impossible to educate people in the time at our command. More and more facts come to light each year, so that there is more each year to know. Indeed, he said, there is now so much to know that it is almost impossible to know much. A distinguished science teacher once complained to me of the difficulties of teaching science. "You see," he said, "we have to teach the science of 1933; the science of 1932 is already out of date." I did not ask him why he bothered to teach the science of 1933 when it would be out of date in 1934. So much is known, so much is being discovered, so many new fields are opening up that understanding through analysis requires more courses, more hours, more laboratories, and more departments. And yet, Whitehead has pointed out, "The increasing departmentalization of universities has trivialized the intellect of professors." Galen would have said the same thing.

We see then that the development of modern medicine, though its record is a grand one, has carried with it surprising losses in general intelligibility of subject matter, with unfortunate effects on research and practice, not least in problems of personality. We see that the general unintelligibility of the subject matter has confused the public and drawn its attention to spectacular or trivial details, to which it has reacted in accordance with well known economic and psychological "laws." We see too that medical education, like all education, has broken down into smaller and smaller compartments, since the subject matter is intelligible only in terms of the volume of known facts which must be covered by the student and the scholar. Do not misunderstand me. The kind of analysis which medicine has pursued, under which the concrete data of a science are divided, classified, and selected for specialization, has resulted in the accumulation of tremendously valuable data and in the development of new and

effective therapeutic modes. It has invented instruments, established laboratories, built schools of medicine, and endowed research foundations. It deserves all the praise it has received. But as the Renaissance could accuse medieval medicine of being rich in principles and poor in facts, we are now entitled to inquire whether modern medicine is not rich in facts and poor in principles.

How did Galen secure his extraordinary balance of speculation, observation, and experiment, and how can we regain that balance today? He took his stand on Aristotle's physics, which was not mechanics, but which was a statement of the general principles applicable to change and motion in Nature. These principles governed change and motion in organisms as well as in inorganic things. The development of these principles led to the insight that the microcosm mirrors the macrocosm, and the problem of medicine is the relation between the two—another way of saying that the problem of medicine is the organism as a whole.

Here we see another mode of analysis than that which modern medicine has employed. It is less showy, and has been generally suppressed for 200 years. It concerns the abstract rational content of a science. It is sometimes spoken of as the interpretation of data, the analysis of fundamental concepts, or in medicine as the correlation of the sciences which lie at the basis of the medical arts. It should be recognized as the fundamental constituent of a science, without which all the rest is ultimately worthless. The proper immediate subject matter of a science is its abstractions, as can be seen as soon as the question is asked, what is the basis of the division, classification, and selection of the concrete material? The answer, contrary to Francis Bacon, is that the basis must be found in the rational science, which is logically prior to the empirical operations involved.

We can thus discover why and how Galen saw, through Aristotle, the problem of the organism as a whole. Rational analysis finds and orders abstractions which can be organized into wholes, and it is by the application or recognition of these abstract wholes in concrete material that we understand things in nature. Questions of mechanism, materialism, vital principle, structure and function can be answered if the abstractions in the analysis have been thought through, and not otherwise. The present confusion rests on doctrinaire empiricism, the antidote to which is the recapture of the rational science or sciences that lie hidden in medical knowledge.

In the absence of such rational science or sciences each other science orders its abstractions on a limited set of categories and offers its uncritici-

cized results to the scientific world. The recipient of these results has with his present training the almost impossible task of reinterpreting the data in this raw form. He should be able to put them to work in his own science; but he has no rational scheme in which he can locate them. Whitehead has lately shown the fatal consequences that have overtaken theories of inheritance because biologists regarded genes as hard pellets of matter which were not affected by their environment. These fatal consequences ensued because of the inability of one science to keep up with the speculative progress of another. Only the development of rational sciences at the base of medicine can integrate the sciences and make true interchange between scientists possible.

The three "departments" of the medieval university, and the only ones, were medicine, theology, and law. These three fields were so studied as to deal with the same propositions and facts, but with different ultimate references. Medicine thus penetrated the whole of medieval thought, and was penetrated by the rational sciences of theology and law. Equipped through training in the seven liberal arts to effect transformations in any subject matter, the student continued in one of these three fields without losing consciousness of the rest. Thus he never forgot the organism as a whole, living in society and under God. Today, filled with little useless facts, 60 per cent of which he has had to repeat to pass countless quarterly tests, his intellectual interest stifled by the hopeless prospect of acquiring all the information he is told he must possess, the student treads his weary round, picking up a fragment here and a fragment there, until he has been examined on fragment after fragment and has served his time. Without intellectual scope or grasp, with the belief that thought is memory and speculation vanity, with no obvious incentive but the need to make a living, he becomes the proud product of our institutions of higher learning. I do not urge a return to the Middle Ages. We are shocked to note the musty formality that at length overtook the ideas of Plato and Aristotle. But I do suggest a return to that conception in which the result of general education is clear and distinct ideas, and the end of university training some notion of humanity and its destiny. Now that health has succeeded happiness as the ruling passion of mankind, your profession has an obligation to be intelligible and intelligent surpassing that of any earlier day. To that end I recommend a return to Galen, perhaps only another way of saying what Galen said in the title of one of his treatises, "The Best Physician Is Also a Philosopher."

PRESENTATION OF HONORARY FELLOWS

FRANKLIN H. MARTIN, M.D., F.A.C.S., CHICAGO

AT the Convocation on Friday evening, October 13, Honorary Fellowships were conferred by the President on the following eminent surgeons:

Professor Robert Marshall Allan, Melbourne, Australia—Doctor of Medicine; Fellow of the Royal College of Surgeons of Edinburgh and the British College of Obstetricians and Gynecologists; Professor of Obstetrics in the University of Melbourne; official delegate to the American College of Surgeons from the Royal Australasian College of Surgeons, of which he is a Fellow. Introduced by Associate Director Malcolm T. MacEachern.

Major General Robert U. Patterson, Washington, D. C.—General Patterson is well known to every medical man who served overseas. He was the Army representative of the American Red Cross in France during the early period of the Great War. Later he was the commanding officer of the Harvard Unit. He received the Distinguished Service Medal for his tireless energy, his military attainment, his marked devotion to duty, and administrative ability. He is now the Surgeon General of the United States Army. Introduced by Treasurer Frederic A. Besley.

Rear Admiral Perceval Sherer Rossiter, Washington, D. C.—Admiral Rossiter was selected by President Roosevelt to be Surgeon General of the Navy because of his exceptional professional and executive ability. He was appointed solely because of these qualifications, and those who know Admiral Rossiter appreciate that it was a wise and happy choice. Introduced by Rear Admiral Cary T. Grayson.

Professor Harold Beckwith Whitehouse, Birmingham, England—Master of Surgery; Bachelor of Medicine; Fellow of the Royal College of Surgeons of England; Professor of Gynecology and Obstetrics, University of Birmingham; official delegate to the American College of Surgeons from the British College of Obstetricians and Gynecologists, of which he is a councilor. Introduced by Regent C. Jeff Miller.

PRESENTATION OF CANDIDATES—CLASS OF 1933

FRANKLIN H. MARTIN, M.D., F.A.C.S., CHICAGO

IN behalf of the Board of Regents of the American College of Surgeons, I have the honor to present for Fellowship in the College candidates as follows:

United States	597
Canada	17
China	3
Honduras	1
England	1
New Zealand	1
Persia	1
Syria	2
Total	623

Each year as we receive a new class of candidates into Fellowship, I am impressed by the prestige of an institution that can influence such a goodly number of busy practitioners of surgery to seek its portals.

To the casual observer of these men and women, it might appear as just one more group that is being enrolled into our ranks. Complacently, this observer shrugs his shoulders and reflects: "How easy!"

As an illustration let us enumerate the facts:

There were 4,919 applications for Fellowship on file January 1, 1933. Nine hundred and five of them were already approved by their State or Provincial Committees on Credentials; 1,558 were presented to State and Provincial Committees on Credentials during this year. Of these only 692, or 44.4 per cent, were approved and recommended for examination. Of the total recommended for Fellowship before and since January 1, 1933 (1,716) our careful sifting process has admitted to Fellowship only 623, or 36.3 per cent, constituting the candidates who are here present. Of the total 4,919 applications that were on file January 1, 1933, the 623 accepted candidates represent only 12.7 per cent approved, or 1 in every 8 applicants.

Surely if we pay tribute where tribute is due we must pay full portion to the magnificent group which is before us this evening. Veritably they are the survival of the fittest.

They are to be congratulated; and the *College* is to be congratulated; but above all, we must congratulate those who may seek their services.

Mr. President: Inasmuch as the candidates herewith presented have fulfilled all of the requirements for admission and have affirmed the Fellowship Pledge of the American College of Surgeons, on authority of the Board of Regents of the College, I take great pleasure in presenting them for Fellowship.

CASE HISTORY HONOR LIST AND PRIZE AWARD

ALLEN B. KANAVEL, M.D., F.A.C.S., CHICAGO

THE use of instruments of precision, chemical, bacteriological, and physiological studies have assumed such importance in the later development of the science of diagnosis, that they threaten to lead to the neglect of the analysis of the symptoms by the attending surgeon.

The X-ray, blood pressure apparatus, microscope, stomach tube, cystoscope, bronchoscope, electrocardiograph, chemical, blood, and physiological studies while of great importance should never eliminate the greatest factor in diagnosis, the careful clinical study of the patient himself.

The Editorial Board of SURGERY, GYNECOLOGY AND OBSTETRICS are so heartily in sympathy with the program of the College and its demands that all patients should receive careful study, as evidenced by adequate records, that in 1930 they asked of the Board of Regents the privilege of presenting an annual prize in the form of a life Fellowship in the American College of Surgeons for the most acceptable set of case records presented by the candidates during the preceding year. The prize consists of five hundred dollars, invested in the name of the successful candidate for life dues in the American College of Surgeons, and is accompanied by an appropriately engraved certificate of appreciation on behalf of the donor, SURGERY, GYNECOLOGY AND OBSTETRICS.

Prize winners of the last 3 years have come from Louisiana, Texas, and Montana, respectively.

The Committee of the College on History Reviews have selected 45 histories, outstanding because of their evidence of careful study of the patient. From these, 5 sets have been selected as the best and the authors of these records have been placed on an honor list. May I ask each honor man to rise as his name is read?

E. G. Bovill, Detroit, Michigan
J. Daniel Willems, Chicago
Dean C. Burns, Petoskey, Michigan
Theodore H. Hanser, St. Louis, Missouri
Sobisca S. Hall, Fairmont, West Virginia

And now, may I announce the prize winner from among this group and invite him to the platform to receive the certificate of appreciation from our official journal, and the formal receipt for life dues in the American College of Surgeons?

Will Dr. Hall please come to the platform?

Dr. Hall, this recognition of your work is an expression by the College of its belief that scientific investigation, careful records, and critical analysis of case histories elevates the standard of surgery and insures to patients the most efficient care. It is our hope that this expression of commendation may serve to stimulate others to emulate your example, advance the frontiers of surgical knowledge, and benefit those entrusted to our care. I congratulate you.

SYMPOSIUM: CANCER IS CURABLE

THE CURABILITY OF CANCER

FRANKLIN H. MARTIN, M.D., F.A.C.S., CHICAGO

MAY I cite briefly the objectives that were in my mind when this yearly symposium on the "Curability of Cancer" was established in 1932? Through the reports of cancer cures that will follow, it is my hope:

1. To impress upon the practitioners of scientific medicine, and indirectly upon the public, the fact that carcinoma is curable by the use of well known and established methods of treatment.

2. To point out in a convincing manner that if all cases of cancer could be diagnosed early and treated promptly in their incipiency, the annual death rate from the disease, now recorded as 150,000 in the United States and Canada, would be reduced by at least 33 per cent, or 50,000 per year. Even if only one-half of the cancer cases could be diagnosed early and properly treated, the mortality rate would be reduced by 25,000 per year.

3. To bring together the group of distinguished clinicians who reported last year, and those who are here present—an overwhelming authority—to present definite statements of the impressive number of cases of cancer that have actually been cured. This preponderance of evidence, so convincing as an object lesson, will impel ever increasing numbers of the people to demand facilities, through scientific doctors, for annual or semiannual examinations, so that not only cancer but any and all diseases may be discovered in their incipiency, when they are amenable to treatment.

4. To secure the maximum of ethical publicity of the reports. This will furnish convincing evidence to our hospitals, our local medical societies, and our already established clinics, and encourage them to furnish facilities whereby every physician who is practicing scientific medicine will have available the necessary equipment and trained aids to insure the comprehensive examination of his patients.

5. To convince the profession and the public that even though cancer is already apparently in a later stage of its development, if it is subjected to proper treatment its progress may often be delayed and the disease not infrequently cured; to make these facts so obvious that a general policy will be established to treat systematically every case of cancer, in whatever stage of advance, not only because of the immediate or remote possibility of a cure, but because palliative measures would bring about great relief of distressing symptoms and encouragement instead of forlorn hope.

6. To establish a universal policy among physicians and surgeons to report *cancer cures* rather than to present the involved comparative statistics that dwell particularly on the cases not cured.

If we here present accomplish the full humanitarian purposes for which this yearly symposium was organized, the discouraging psychosis that now exists in the minds of the profession as well as of the public will be dispelled; a consciousness that *cancer is curable* will be established in the minds of all; fear will be displaced by a spirit of hopefulness; and every victim of cancer or suspected cancer will present himself for early diagnosis and treatment.

CANCER CURES—1932 AND 1933

Cervix	6,669
Fundus	1,223
Cervix and fundus	98
Ovary	564
Vagina and vulva	75
Breast	8,051
Mouth and lip	1,506
Stomach	909
Colon and rectum	2,067
Kidney	255
Bladder	547
Prostate	108
Testis	78
Penis	24
Skin	1,124
Thyroid	465
Larynx	110
Eye	22
Bone	173
Other classifications	380
Grand total cancer cures 5 years and over	24,448

Last Year—1932			*This Year—1933*		
Reports of speakers at symposium on Curability of Cancer, 1932			Reports of speakers at symposium on Curability of Cancer, 1933		
Cancer cures, 5 years and more	4,348		Cancer cures, 5 years and more	3,902	
Registered cases of American College of Surgeons, 1932			Registered cases of American College of Surgeons, 1933		
Cancer cures, 5 years and more	1,263		Cancer cures, 5 years and more	547	
An incomplete recent survey of cases registered in the literature, 1932			An incomplete recent survey of cases registered in the literature, 1933		
Cancer cures, 5 years and more	3,089		Cancer cures, 5 years and more	10,638	
Report presented at St. Louis Clinical Congress	140		Speakers in 1932 symposium report additional cures in 1933	521	
Total, 1932		8,840	Total, 1933		15,608
			Grand total of reported cancer cures		24,448

CANCER AS AN ARRESTABLE DISEASE

CHARLES A. DUKES, M.D., F.A.C.S., OAKLAND, CALIFORNIA

THE work of the cancer clinic at Highland Hospital, Alameda County, California, where only the indigent are cared for, has given an approach to the cancer problem that is probably unique. The clinic, which was organized and began to function 3 years ago, necessarily has not given us an opportunity to study "5 year cures" but on the contrary has given us an opportunity for the study of that class of cases that falls in the classification, I believe improperly termed, the "incurable and inoperable cases."

I believe that the psychology of our patients has been much improved by doing something for them; naming the disease and explaining to them that although it is in an advanced state proper treatment will arrest the disease, if not entirely remove it.

We believe that in expressing opinions upon the treatment of cancer, it would be well, in advanced cases, to use the term "arrestment," rather than inoperable or incurable. If we look back over the history of tuberculosis, we will find that there was as great a fear and as much discouragement when a diagnosis of pulmonary tuberculosis was made as there is now in the diagnosis of advanced types of cancer.

A survey of the psychology of the laity in regard to the treatment and care of tuberculosis shows an entire change in attitude. Assuming that the diagnosis of tuberculosis has been made and that you have the hearty co-operation of the patient and all interested in the proper treatment, they are told that the treatment of tuberculosis involves a year or more in a sanitarium with rest in bed and limited activity for a much longer period. This is all accepted without dissent, for faith has replaced fear.

Would it not be better if we could establish the same psychology in the minds of the laity in regard to cancer, so that when a diagnosis is made, instead of everyone connected with the case trying to hide the disease, and the patient even going into seclusion, and possibly the doctor telling him of the hopelessness of the situation, we establish the same hopeful psychology in the patient and his friends as in tuberculosis, showing them that an arrestment, if not a complete cure, is possible, and that the patient may entirely outlive his expectancy in comfort even though the disease is not entirely removed. Why not give this type of case the same hope and encouragement that we give to the tuberculous—class them as arrestable and then group them according to type and severity, and begin a systematic study of their treatment and proper disposition?

I am convinced that a cancer organization similar to that of the tuberculosis association will be necessary, that it is by this approach to the subject that we are going to gain the confidence of the public, and that it is when this confidence is obtained that we will get control of the early and curable cases.

We owe much of the success of our clinic to the help of our fellow-workers in cancer—Lee; Greenough; Martin; Crowell; MacEachern; Robert C. Coffey, of Portland; Kilgore; Soiland; and others from home and abroad who have visited the clinic and advised with us in diagnosis and treatment.

Although discouragements are many, I am sure that the organization of the many clinics in general hospitals that are being particularly sponsored by the American College of Surgeons are to be fruitful of much good, not only in the early diagnosis, but in efficient treatment.

All visitors to the clinic are invited to enter into the discussion of each case, and the doctors are becoming cancer minded. Thus are the members of the medical profession benefited by the money paid by the taxpayers for the medical care of the indigent. The advanced cases are being well treated by trained men so that cancer cases are drifting less to the quacks and the much publicized cures.

If this discussion today can create confidence and hope in the patient and stimulate a greater activity on the part of the profession in the treatment of the advanced cases of cancer, I believe much will have been accomplished. Of course, no paper on cancer should be presented that does not carry with it a plea for the earlier diagnosis and efficient treatment of cancer.

The encouraging factor in the treatment of advanced cancer is the fact that there are many things that can be done to relieve pain and arrest growth. Deformity, the bugbear of treatment of cancer, must be forgotten. The use of the Percy cautery, the radio-knife, and improved surgical technique, together with radium and X-ray make the treatment much more hopeful than it was formerly believed it could be. Certainly those cases that have broken-down growths about the face, breasts that are sloughing and are unbearable because of the discharges and odor, carcinoma of the cervix, bleeding and foul, can all receive great benefit, and many times years of arrestment.

We must bring the cancer case back into the field of hope and into a life of greater comfort, cure, or arrestment.

FIVE YEAR CANCER CURES IN THE SOUTH

FRANK K. BOLAND, M.D., F.A.C.S., ATLANTA, GEORGIA

THE title of the paper was submitted with the idea of discussing 5 year cancer cures among the southern negroes. The result of the study as to volume is disappointing, because of the difficulty of tracing such patients 5 years and more after they have left the hospital. The data collected, however, contribute a quota to support the object of the symposium, for they show that, if treated early and properly, many cases of cancer are curable.

During the 11 year period, 1922–1932, among 55,500 admissions to the Emory University Division (colored) of the Grady Hospital (municipal), Atlanta, there were 694 patients treated for malignant disease, 1.7 per cent. Of these patients 203 died in the hospital, and 491 were discharged alive, a considerable number being apparently cured.

Formerly it was supposed that the colored race was not as susceptible to cancer as white people. In slavery times in the South few negroes were reported to suffer from the disease. Today the proportion of cancer cases is almost the same as in the white race. Full blooded negroes and mulattoes are equally susceptible.

In this series of 694 patients, 74 per cent were women; most of the cases were in the carcinoma of the cervix uteri group. The principal organs involved were as follows:

	Cases	Per cent
Cervix uteri	211	30
Fundus uteri	33	5
Breast	123	18
Stomach	61	9
Prostate	43	6
Rectum	21	3
Penis	14	2
Colon	12	2

In the negro the percentage of cases of cancer of the prostate and penis is greater and the percentage of cases in which the stomach and colon are involved is less than in white people. Our statistics show that the incidence of all surgical diseases of the digestive tract is but one-fourth as common in the colored as in the white patients.

The fact that 30 per cent of the patients with malignant disease who entered the hospital were discharged deceased illustrates how far advanced the disease was before such people sought proper relief. The majority of the 70 per cent who left the hospital alive died in less than 5 years, but we are convinced that more patients have survived this test period than can be found. Negroes change their residences with amazing frequency, and often change their names,

and many times when the investigator appears and asks questions, the family and friends grow suspicious of something, and "don't know nothin'."

In spite of this handicap, 21 patients in the group with positive clinical and laboratory evidence of malignancy were found to have lived 5 and more years after surgical and radiation treatment. One patient with sarcoma of the penis died at the end of 5 years, and another patient with fibrosarcoma of the thumb died from typhoid fever 5 years after amputation. Today there are 9 cases of cancer of the cervix, in which radium treatment was used, and the patients lived from 5 to 8 years; 9 patients with adenocarcinoma of the breast, treated by amputation (2 with axillary involvement), lived from 5 to 12 years; and 1 patient with scirrhus carcinoma of the pylorus, treated by the Billroth II operation, is living after 9 years. These patients were treated by different members of the hospital staff, including 2 by the writer—the stomach case and 1 of the breast cases.

Another group is reported consisting of 29 cases of 5 year cancer cures in white patients treated by the writer during the past 14 years. These cases also presented positive clinical and laboratory evidence of malignancy, frequently confirmed by more than one pathologist.

There are 6 patients with adenocarcinoma of the uterus living from 5 to 14 years after hysterectomy, and 1 patient with sarcoma of the uterus living 7 years after hysterectomy. There is 1 patient living 5 years, and another patient 14 years, after hysterectomy for carcinoma of the cervix; 1 patient living 5 years after amputation of the cervix for carcinoma, and 3 patients living from 5 to 9 years after the application of radium for the same disease. One patient treated with radium for carcinoma of the cervix has since developed carcinoma of the body of the uterus.

The patients with cancer of the breast number 11, 3 of whom had palpable axillary glands; 8 are reported living and well from 6 to 10 years after radical amputation. One patient died 5 years after operation from recurrence, while another patient died 5 years after operation, and another 7 years after operation, from cerebral hæmorrhage.

The other patients in the series are alive and well as follows: one, 11 years after nephrectomy for spindle cell sarcoma of the kidney; one, 8 years after amputation of the penis for carcinoma; one, 5 years after prostatectomy for adenocarcinoma; one, 5 years after operation for carcinoma of the face; one, 7 years after operation for sarcoma of the neck. The time limit forbids detailed discussion of interesting features connected with these cases.

The medical profession and the public owe a debt of gratitude to the distinguished Director-General of the American College of Surgeons for his leadership in sounding a cheerful note about the cancer problem. The disease is curable by well known and established methods of treatment.

FIVE YEAR CURES IN CANCER

JOHN J. GALLIGAN, M.D., F.A.C.S., Salt Lake City, Utah

FOR the past 30 years the mortality rate in cancer has risen steadily throughout the world, and in the United States it has gradually mounted in the past 50 years until it is now the second leading cause of death. With the passing of nearly 125,000 afflicted annually, or well over a half million in a given period of 5 years, a most formidable problem for solution is offered to the members of the medical profession.

With such figures at hand it is not surprising that the laity has come to regard cancer as practically a hopeless condition, characterized by a torturing period of pain and suffering. In the minds of the majority of people there is an ingrained notion that cancer in each and every one of its varied forms is absolutely incurable and that a diagnosis of malignancy is tantamount to a sentence of death. Tuberculosis, pernicious anæmia, diabetes, and many other serious diseases have lost their dread, but cancer still strikes with ghastly terror.

Last year, however, came the heartening information from the report of Dr. Franklin H. Martin[1] that nearly 9,000 cures, extending over a period of 5 years, had been reported and verified. While knowledge of these cases of recovery has reached

[1]Martin, Franklin H. Curability of Cancer. Surg., Gynec. & Obst., 1933, lvi, 412.

a large number of the medical profession, it has been an unfortunate and deplorable circumstance that the average layman in many communities has not had the same opportunity.

The hour seems now at hand, however, when approval has been given for definite plans to educate our own and forthcoming generations in the early recognition and control of cancer. Not with the idea of creating a fear of the disease, but to overcome the well known reluctance manifested on the part of the patient in seeking proper advice and counsel before it becomes too late.

With determination and fortitude we are entering upon a new phase of scientific advancement that does not frown upon publicity in a sincere effort to combat a relentless enemy. Today from city, town, and hamlet, a group of earnest physicians and surgeons has gathered to carry on a splendid movement, the evaluation of which only time can tell in definite results.

To this meeting I bring a small contribution of cures which have encouraged and at the same time depressed me. In so far as the diagnosis in many other cases might have been made earlier, so also the sacrifice of human life would have been greatly curtailed. For those who have recovered and remain entirely free from recurrence, it is indeed encouraging to know that cancer, seen early, is a curable disease.

The cases of patients reported as cured are as follows:

CASE 1. Mrs. Mc., aged 60 years, a widow, had a small ulcerated area on the left cheek, which had been present 6 months. No previous treatment had been given except the application of ointments. On July 29, 1928, under local anesthesia, an elliptical incision was made and the growth was removed. Pathological diagnosis: epithelioma.

CASE 2. T. P., aged 54 years, a rancher, had a small area below the right eye which showed repeated scaling and slight bleeding. X-ray treatment of 3 exposures had been given, with no return over a period of 8 years. Diagnosis: epithelioma.

CASE 3. E. R., aged 64 years, had a small scaly area at the left nasolabial fold. This had been present several weeks. There was marked induration around the base of the epithelioma. One application of electric cautery was made and there has been no recurrence of the growth over a period of 10 years.

CASE 4. N. P., aged 84 years, had a small swelling with ulceration on the lower lip. This had been present 7 months. On August 27, 1928, a V-shaped excision was made and the growth removed. Pathological diagnosis: epithelioma.

CASE 5. Mrs. K. O'C., aged 58 years. Patient first noticed a small lump in the left breast in 1922. A small gland enlargement in axilla appeared later. Radical amputation of breast and axillary glands was done on December 14, 1925, and there has been no recurrence to present date. Pathological diagnosis: schirrous carcinoma.

CASE 6. Mrs. C., aged 52 years. Amputation right breast for cancer was done in February, 1918. In September, 1925, patient noticed a tumor in the left breast with bleeding from nipple which persisted for a period of several months. Radical amputation of remaining breast was done and there has been no recurrence to date. Pathological diagnosis: adenocarcinoma.

CASE 7. Mrs. M. H., aged 59 years, had an enlarged adherent mass in the outer quadrant of the left breast. Radical amputation was done in February, 1922. There had been no recurrence of the malignancy when last seen, in June, 1933. Pathological report: adenocarcinoma.

CASE 8. Mrs. L. B., aged 42 years, had a nodule in the right breast with retraction of nipple. Radical amputation was done April 20, 1920. There has been no recurrence. Pathological diagnosis: adenocarcinoma.

CASE 9. F. G., aged 48 years, a clergyman, had noticed a mass in the left hypochondrium for 7 months. The mass gradually increased in size, was painless, and slightly movable. On June 28, 1928, resection of 10 inches of the transverse colon with anastomosis was done. He had a stormy postoperative course. Pathological report: adenocarcinoma of the transverse colon. Complete recovery followed operation and there has been no recurrence to present time.

It occurs to me that, with such favorable reports brought annually to these symposia, the effort to interest the laity in this vital problem will be rewarded beyond the hope of our most sanguine expectations. Earlier recognition, more accurate diagnoses, radical surgical procedures, supplemented by roentgen and radium therapy, will do much to lessen anxiety and fear. An optimistic rather than a pessimistic outlook will produce "cancer consciousness," and gradually eliminate the tragic story of the past. Intelligent co-operation between the afflicted individual and his medical adviser will assure a favorable end-result. In this alone, as in all other lines of human endeavor, "eternal vigilance will be the price of victory."

FIVE YEAR CANCER CURES

IRVIN ABELL, M.D., F.A.C.S., LOUISVILLE, KENTUCKY

THE aggregate number of 5 year cancer cures reported at the last meeting of the American College of Surgeons was 8,840, affording inspiration and encouragement in dispelling the gloom with which both the profession and the laity are wont to regard this subject. Each Fellow of the College should feel it a duty to make an accurate follow-up of the cancer cases that have come under his care with the view of demonstrating the curability of cancer as well as the prolongation of life afforded by its treatment. By so doing not only will these ends be attained but the accumulated material will offer a basis for the correct evaluation of the methods of treatment now employed in its alleviation and eradication. With this in mind the accompanying tables of results obtained in our experience in treating carcinoma of the breast, colon, and uterus are submitted.

TABLE I.—CARCINOMA OF THE CERVIX

Number of cases treated to August 1, 1928	56
Number of cases traced	44
Number of cases untraced	12

	Radium	Hysterectomy	Radium and hysterectomy	Palliative
Treated prior to August 1, 1928.	35	16	2	3
Living 5 years or more	6	4	0	0
Died of intercurrent disease	1	2	0	0
Died of recurrence	12	6	1	2
Untraced	6	4	1	1
Living 5 years or more, all cases	17.6%	28.5%	0%	0%
Living 5 years or more, traced cases	21.4%	40%	0%	0%

TABLE II.—CARCINOMA OF BODY OF UTERUS

Treated prior to August 1, 1928	39
Number of cases traced	32
Number of cases untraced	7

	Radium	Hysterectomy	Radium and hysterectomy
Treated prior to August 1, 1928	13	19	7
Living 5 years or more	5	14	3
Died of intercurrent disease	0	0	0
Died of recurrence	6	2	3
Untraced	2	3	1
Living 5 years or more, all cases	38.4%	73.6%	42.8%
Living 5 years or more, traced cases	45.4%	87.5%	50%

TABLE III.—CARCINOMA OF COLON AND RECTUM

Total radical resections to August 1, 1928	33
Operative mortality (24.2 per cent)	8
Results known in	23
Untraced	2
Five Year Period	
Deaths from recurrence	7
Untraced	2
Percentage of deaths and untraced	36
Living at end of 5 years (64 per cent)	16
Ten Year Period	
Dead at 7 years following operation from pneumonia	1
Dead at 9 years following operation from cerebral hæmorrhage	1
Dead at 6 years following operation from recurrence	2
Dead at 9 years following operation from cholecystitis (recurrence)	1
Living at 6½ years following operation	2
Living at 7 years following operation	2
Living at 8 years following operation	1
Living from 10 to 18 years following operation (24 per cent)	6

TABLE IV.—CARCINOMA OF THE BREAST—FIVE YEAR GROUP

		Microscopical report on nodes		
		With involvement	With no involvement	No report
Total operations to August 1, 1928	217	97	61	59
Patients living 5 years or more	100	24	44	32
Deaths from recurrence	79			
Deaths from intercurrent disease	9	5	3	
Deaths incident to operation (1.8 per cent)	4			
Patients untraced 5 years or more	25	8	3	14
Percentage living in total 5 year cases	46	26	75.8	
Percentage living in traced 5 year cases	53	28.5	80	

TABLE V.—CARCINOMA OF THE BREAST—TEN YEAR GROUP

		Microscopical report on nodes		
		With involvement	With no involvement	No report
Total operations to August 1, 1923	136	50	25	61
Patients living 10 years or more	40	10	16	14
Deaths from recurrence	52			
Deaths from intercurrent disease	14	9	5	
Deaths incident to operation (2.2 per cent)	3			
Patients untraced 10 years or more	27	8	3	16
Percentage living in total 10 year cases	29	24.3	80	
Percentage living in traced 10 year cases	38	30	94	

CANCER OF THE LARYNX; ITS CURABILITY BY LARYNGOFISSURE

CHEVALIER JACKSON, M.D., Sc.D., LL.D., F.A.C.S., PHILADELPHIA

IN considering the curability of cancer of the larynx, it should be stated at the outset that nowhere else in the internal surfaces of the human body has there been obtained a higher percentage of cures of cancer than in the larynx, provided we limit our statistics to the curable class of case, namely, early intrinsic cancer. In the larynx, as elsewhere internally, there is a hopeless class. In cases of late laryngeal cancer, extrinsic by origin or extension, with involvement of the cervical lymph nodes, 5 year cures are not to be expected.

The word "cure." Review of the literature reveals the fact that some writers attach a very peculiar and unwarranted meaning to the word "cure." They seem to think that cure means the patient will never have cancer again. This is quite as absurd as to expect that a man who has never had cancer will never get it. A man who is free from recurrence 5 years after removal of a cancer is no better off than a man who has never had one. He, as a well man, developed a cancer; after operation he is no better than well. We cannot confer immunity by operation. We are justified in saying that a patient free from cancer for 5 years after operation is cured. If he develops a cancer afterward, even at or near the same location, it is a new process that he would have had anyway and not a repullulation of the primary process.

Causes of incurability. It is a curious and appalling thing to realize that, as our statistics show, only 19.3 per cent of the patients with cancer of the larynx come to the surgeon at a stage of the disease curable by laryngofissure. This is difficult to understand when we recall that (1) it requires only a very small growth on a vocal cord to cause the hoarseness; (2) no painful, distressing, or embarrassing examination is required to see a suspicious lesion in the larynx. The chief reason seems to be that the patient takes it for granted his hoarseness is due to laryngitis that will clear up, hence he does not go to his physician. This neglect is contributed to largely by the fact that the patient has had, like all mankind, many previous attacks that were really laryngitis and got well spontaneously. The layman must be taught that hoarseness lasting longer than 2 weeks may be due to cancer of the vocal cord, and that his family physician should be consulted at once. If no cancer is present no harm will have been done and the patient's mind may be set at rest; no dread of cancer need result.

Curability of cancer of the larynx. In the general study of the whole cancer problem all cases encountered should be reported; but when we wish to present evidence that cancer is curable it entangles the presentation in a hopeless mess of involved statistics which include hopeless or even borderline cases. We all know that cancer in most regions of the human body is curable if encountered in the curable stage. There are many cases encountered at a later stage in which the surgeon's conscience forces him to give the patient what prolongation of life he can though the case is nearly hopeless. This is proper, but *these cases should not be taken as a criterion of the curability of cancer as applied to patients who come for treatment in the unquestionably curable stage.* This presentation applies to the latter class of case only.

Precancerous conditions. Purists fond of academic argument sometimes object strongly to the use of the word precancerous (6). As a word it may be objectionable but there is no other that is applicable to certain conditions that every histologist and every experienced surgeon, if either of them were the patient, would wish to have radically extirpated lest they develop cancer. As Dr. James Ewing said apropos of one such case of growth in the larynx, "That is the time to cure cancer; not after it is fully developed (5)." In the larynx, leucoplakia and some forms of benign growths fall in this category.

Class of case in which cancer of the larynx is curable. It now has been proved unequivocably that cancer of small extent limited to the intrinsic area of the larynx is curable in about 80 per cent of the cases by the relatively minor operation of laryngofissure. This result has been obtained by so many different operators as to place it beyond question. The ideal case is one in which a small growth is located on the free edge of the vocal cord. The yellow elastic tissue of the cord is tendinous in character containing few vessels and lymph channels. The edges of the cords are not covered with true mucosa, there are no glands, only a thin firm layer of epithelium. The lymphatic drainage is unusual. All of the lymph channels empty into two nodes, one on either side, and neither has any demonstrable efferent vessels.

Personally we feel that 3 years' freedom from recurrence indicates adequate removal, but for the

purposes of this meeting we have collected approximately correct statistics limited to patients operated upon by us more than 5 years ago. In the cases included in this series the patients were all suitable for laryngofissure. The statistics therefore afford no criterion as to the results when this operation is done on unsuitable cases; in fact, the recurrences would be about 100 per cent if the operation were to be done upon patients with extensive late cancer.

In the tabulation of cases, for reasons mentioned, only the cases are included that were deemed in every way suitable to operation by laryngofissure.

PATIENTS OPERATED UPON BY LARYNGOFISSURE PRIOR TO FIVE YEARS AGO

	Cases
Alive and well after 31 years	1
Alive and well after 35 years	2
Alive and well after 23 years	2
Alive and well after 5 to 15 years (thereafter untraced)	15
Alive and well after 14 years	2
Alive and well after 13 years	1
Alive and well after 10 years	3
Alive and well after 7 years	4
Alive and well after 5 years	11
Total alive and well 5 or more years	41
Died of recurrence before the end of 5 years	9
Died of cancer of other regions without local recurrence	2
Died of diseases other than cancer within 5 years	3
Untraceable after 1 year	19
Total number of patients in this series	74

Recapitulation. Of 74 patients with cancer of the larynx suitable for laryngofissure operated upon prior to 5 years ago 55 were traceable. Of these, 5 died without recurrence of cancer in the larynx. Of the 50 remaining patients 9 died of recurrence of laryngeal cancer, 41 (82 per cent) were alive and well for periods of from 5 to 31 years.

In 1 of the 74 cases the growth was a sarcoma, 1 an endothelioma, 1 a basal cell carcinoma; all the others were squamous cell carcinomata. Only the latter were in the cured group.

Laryngofissure. Consideration of the technique of this operation would be out of place here. One phase of the matter, however, should be mentioned. When we used the turbinotome to clip the thyroid cartilage in all cases, our statistics fell to 79.3 per cent 3 year cures. Since we have been using our special technique, which avoids entering the cavity of the larynx before the subperichondrial dissection has been completed, our statistics have improved to 82 per cent 5 year cures.

CONCLUSIONS

1. Early intrinsic cancer of the larynx is curable by laryngofissure in 82 per cent of the cases.

2. It is seen in this curable stage in only 19.3 per cent of the cases.

3. The chief cause of this deplorable fact is that the patient in the early stages thinks his hoarseness is due to laryngitis.

4. The pessimism of the laity as to the curability of cancer is based upon operations in late cases.

5. The laity should be taught 2 things, namely,

a. Hoarseness of more than 2 weeks' duration may be early curable cancer and the patient should present himself to his physician for a laryngeal examination.

b. The cure of cancer may be likened to putting out a fire. When the fire consists of the first flames of a few pieces of ignited paper it can be stamped out completely and permanently. When the fire has been allowed to run on until the whole building is aflame and the roof is falling any efforts to stop it are utterly hopeless.

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CURE OF CASES WITH TWO INDEPENDENT CANCERS OCCURRING IN A SERIES OF CASES OF BUCCAL CANCER[1]

CHARLES C. LUND, M.D., F.A.C.S., BOSTON

A THOROUGH survey of the results of treatment from 1918 to 1926 of carcinoma of the buccal cavity and lips has just been completed at the Collis P. Huntington Memorial Hospital (1, 2, 3). In the series were 432 cases of carcinoma of the lip and 1,113 cases of carcinoma of the buccal mucosa. Of these, 175 and 62, respectively, were cured. Among them were many patients with a history of another independent cancer before admission, multiple cancers at admission, or who developed subsequent cancers after admission. Some of these were cases of re-occurrence, that is, second cancer arising in another part of the buccal mucosa. Other second cancers arose in other organs, but in each case at least one lesion was buccal. The follow-up was very thorough from the standpoint of learning the results of treatment given at the hospital, but was not thorough enough to assure that all cases of multiple cancer would be discovered. For this reason the present report probably does not include all the instances of multiple cancer that were cured in this group of patients. A strict 5 year interval of freedom from all of the cancers considered has elapsed in these cases.

Strictness in this regard has led to the elimination of many cases of multiple cancer that presumably have been cured, but in which the second cancer occurred less than 5 years before the date of final follow up. Tables I, II, and III present the location of these cancers. These tables do not show a large series of cases compared to the whole series from which it is derived, but it must be remembered that because of the fact that this is a report on multiple cancer, although there are only 13 patients involved, there are 31 cancers that were cured.

The curability of second buccal and lip cancer. In 4 cases in which the first buccal or lip lesion was cured for 5 years, the patients died from a second cancer of the lip; 3, however, were cured of the second cancer. In 18 cases in which the first buccal or lip lesion was cured, the patients died from a second buccal lesion in comparison to 4 who were cured of the second. The numbers of cases of these re-occurrences are too small to be of great statistical value, but they show, as far as they go, that such second lesions are at least as curable as first ones. This, of course, is not true of recurrent cancer of any kind or location.

Curability of buccal cancer associated with other cancer. The number of cases in this group is so small in comparison with the many different kinds of cancer that occur that presentation of even the simplest statistics can be of no avail. However, the records give a distinct impression that the curability of such cancers, whether they occur at the same time or in series, may be expressed by the product of the fractions representing the prognosis of each of the cancers as if they occurred in two separate people. In other

TABLE I.—CASES WITH PATHOLOGICAL PROOF OF BOTH CANCERS

Case	Location first cancer	Interval of cure, years	Location second cancer	Years
1	Tongue	17	Tongue	13
2	Tongue	10	Inside cheek	9
3	Lip	11	Lip	10
4	Lip	10	Sigmoid	6

TABLE II.—CASES WITH PATHOLOGICAL PROOF OF FIRST CANCER

Case	Location first cancer	Interval of cure, years	Location second cancer	Years
5	Lip	6	Skin	6
6	Lip	8	Skin	8
7	Lip	6	Skin	6
8	Lip	6	Skin	6

TABLE III.—CASES WITH CLINICAL DIAGNOSIS

Case	Location first cancer	Interval of cure, years	Location second cancer	Years
9	Inside right cheek	7	Inside left cheek	7
10	Inside right cheek	13	Inside left cheek	9
11	Lip	9	Skin	8
12	Lip	13	Skin	13
			Skin	6
13	Lip	7	Skin	7
			Skin	7
			Skin	6
			Skin	5

[1]From the Cancer Commission of Harvard University. This work was supported financially by gifts from anonymous donors and a grant from the Delamar Mobile Research Fund of the Harvard Medical School.

words, there is no evidence that two cancers have either a favorable or an unfavorable effect on each other.

TREATMENT

Some of the patients were treated by surgery and some by radiation. It is believed that the indications as to the best type of treatment are no different in cases of multiple than in cases of single cancer.

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A GROUP OF CANCER CASES FROM PRIVATE PRACTICE

ALSON R. KILGORE, M.D., F.A.C.S., SAN FRANCISCO

AS a contribution to this symposium, even though but a small total number of cases are presented, it may be of interest to record the cured cancers from a private general surgical practice. None has been included, therefore, from records at the San Francisco Hospital. Since our private records in San Francisco begin with late 1920, the following brief list of 5 year cures is from the first 7 years. A much larger number are approaching the 5 year period but cannot yet be recorded.

Part affected	Case No.	Glands involved	Years cured
Lip			
1	3522	o	7
2	6899	o	5
3	3600 (neck recurrence from lip)	yes	6
Cheek			
4	3824	o	8
Ear			
5	109	o	12
6	3505	yes	8
Hand			
7	2680	o	8
Roof of mouth			
8	2839	o	6
Basal cell			
9	3354		7
10	4829		5
11	6185		6
12	5313		5
Breast			
13	3821	yes	8
14	3913	o	8
15	5278	o	8
16	5572	o	7
17	4356 (bilateral)	o	8
Cervix			
18	4322		5
19	6241		5
Ovary			
20	3187		8
Sigmoid			
21	5420		6
Thigh (fibro-sarcoma)			
22	2531		10

THE RESULTS IN ONE HUNDRED TRACED CASES OF CANCER

DAMON B. PFEIFFER, M.D., F.A.C.S., PHILADELPHIA

IN acceding to Dr. Martin's request to participate in this symposium on cured cancer, I failed to realize the impossibility of tracing patients operated upon in various hospitals which possessed at that time no follow-up system, by which alone the shifting clientele of metropolitan hospitals can be shepherded into statistical exhibits. By diligent search through an experience of some hundreds of cases, I have run back through a period of 13 years to gather 100 cases of proved lesion, definite attempt at cure and known result. My tabulation possesses but little statistical value except to place on record an additional number of patients who owe their lives to surgery and thereby reinforce our message that cancer is curable.

One of the cases included represents a cure of cancer of the breast treated by the late William L. Rodman, 33 years ago. In that early period of roentgen therapy, however, the patient was badly burned and about 8 years ago began to develop a series of epitheliomata in the area involved. To eliminate these growths I did a series of excisions and plastic operations, finally removing the entire affected skin area, with cure up to the present time.

Only 1 of these patients was treated exclusively by radium, a case of epithelioma of the soft palate, now alive without recurrence for 6 years. During this period other patients suitable for radium treatment were referred to a colleague competent in the use of this agent. The experience therefore represents the salvage by surgery as the major agent, though practically all the external cancers had radium or roentgen therapy as an adjunct. Our present plan in my services in the Lankenau and Abington Memorial Hospitals is to consider and treat all patients suffering from cancer, by the group method.

It is my belief that the cancer case will get the best treatment at the hands of a group consisting of the surgeon, radiologist, pathologist, internist, and specialist in the minor surgical branches, and that the surgeon should be the integrator of the group, provided he has had experience in pathology and has taken the trouble to acquaint himself with the fundamentals of radiotherapy and its real accomplishments. Such a group is possible in any well ordered and equipped hospital. With such arrangements more generally available, we may justly proclaim that we know a cure for cancer, that what we do not know all too often is the existence of cancer in the individual patient in the curable stage, and therefore that an incurable cancer represents not the incurability of cancer but an opportunity lost.

Variety	Years cured									Total cures	Died
	5	6	7	8	9	10	11	12	13		
Breast	2	3	7	3		1	1	1		18	29
Lip and mouth	2	3			1					6	3
Stomach	1									1	10
Colon and rectum		1	1	2						5	10
Uterus and vagina	1					1			1	3	8
Lympho-sarcoma											2
Bone sarcoma						1	2			3	2
Total										36	64

A STUDY OF 432 CASES OF CANCER ON A GENERAL SURGICAL SERVICE BETWEEN 1916 AND 1926

EUGENE H. POOL, M.D., F.A.C.S., AND JOHN A. VIETOR, M.D., F.A.C.S., NEW YORK

OUR figures are discouraging when compared with those of some of the other speakers but they are of value as showing what happens through delay.

We have reviewed all of the cases of carcinoma admitted to the Second Surgical Division of the New York Hospital from 1916 to 1926. They were all ward cases. They belonged, therefore, exclusively to the poor and indigent classes. This is in contrast to the cases reported by the other speakers.

Our series includes 432 cases in which a satisfactory diagnosis was established and 369 with satisfactory follow-up. In 146 cases radical surgery was carried out with the hope of effecting cures. These are the only cases I shall consider. At the end of the 5 year period, 24 were living, approximately 1 in 6. But of these survivors 6 are known to have died of carcinoma, and 1 was lost with definite lung metastases. These 7 cases were breast carcinomata. Therefore in breast cases, a 5 year period is not a criterion of cure, since a considerable proportion of those surviving 5 years subsequently died of carcinoma, in one instance 11 years after operation.

It has not been possible to make an accurate survey of the private cases in which operations were done during the same period, but the results are much more gratifying, probably because the patient in this group is more intelligent and seeks advice at an earlier date. We have had patients who had cancers especially of the breast, colon, and uterus who are in good health over 5 years, one breast case, 17 years; but the number and percentage cannot be stated at this time. The difference in the results in large series of private and public cases is a strong plea for early treatment and for the education of the public toward periodic physical examinations.

One case report should be emphasized. It was published in the *Annals of Surgery* (1924, vol. lxxx, 157). A patient suffering from a sacrococcygeal chordoma was treated with radium; the growth of the syncytial tissue, of which the tumor was composed, was controlled; and she died of senility about 10 years later, with no evidence of extension of the growth or metastases. This case is referred to in order to controvert the statement so often made that a chordoma is not radiosensitive.

A survey of 54 cases of carcinoma of the thyroid in recent years shows that more than 92 per cent originated in adenomata. All the cures that were effected took place in either the papillary or adenomatous type of carcinoma. Recurrences in thyroid malignancy usually are very prompt, so that if a patient survives 1 year the result corresponds approximately with the so called 5 year result of carcinoma in other parts of the body.

In conclusion we emphasize the following points:

1. About two-thirds of the ward patients applied for help when their condition was so far advanced as to be inoperable.
2. In this type of patient only 1 out of 6 treated by radical surgery survived the 5 year period.
3. One-fourth of these developed subsequent metastases or recurrences.
4. The syncytial tissue of chordomata is radiosensitive.
5. Over 92 per cent of carcinomata of the thyroid originate in adenomata.
6. A 1 year result in carcinoma of the thyroid is equivalent to the usual 5 year result in other malignant growths.

FIVE YEAR CURES OF CANCER OF THE BREAST AT THE MASSACHUSETTS GENERAL HOSPITAL

ROBERT B. GREENOUGH, M.D., F.A.C.S., BOSTON

FIVE successive series of cases of breast cancer have been studied and reported from the Massachusetts General Hospital beginning with the year 1894 and ending December 31, 1926. The first series, 1894–1904, was reported on a 3 year end-result basis, but the report recorded 46 of the 71 cases alive and well 3 years or more after operation as having already passed the 5 year limit. The cases of patients entering the hospital in the years 1904 to 1910 and those of the period from 1914 to 1916 have not been collected, with the exception of 8 private cases in the latter period which have been included.

During these years 1,083 patients with cancer of the breast of varying degrees of duration and development entered the hospital, and 220 of these were found to be alive and well at periods of from 5 to 20 years after operation, a total salvage of 20 per cent. The care of these patients was distributed widely among the surgeons of the hospital staff with the exception of the 1911–1914 period, when a special assignment of the breast cancer material of the hospital was made to two surgeons for intensive study.

There were 846 cases considered by the surgeons of the hospital staff as operable ones, and of this number 220, or 26 per cent, were alive and well 5 years or more after operation. There were no 5 year "cures" among the 237 recurrent or inoperable cases in spite of palliative operations and, in the later years, intensive X-ray treatment.

Excluding the cases of the 1894–1904 series, there were 526 operable cases with 174 five year "cures," or 33 per cent.

The cases in the earlier series, 1894–1904, were not so recorded as to permit classification in regard to the extent of the disease in accordance with the record forms of the American College of Surgeons, but those from 1911 to 1926 were so classified, and show that in 158 I-A cases (axillary glands not involved), 98 were 5 year "cures," or 62 per cent, while the 316 more advanced I-C cases (with axillary involvement), gave only 75 "cures," or 24 per cent; a clear indication that early diagnosis and prompt and radical treatment are of the first importance in the treatment of cancer of the breast.

The primary operable cases of the years 1918 to 1926 also have all been studied with regard to the degree of malignancy of the primary tumor. Of 358 cases there were 55 Grade I (low malignancy) with 44 "cures," or 80 per cent; 193 Grade II (medium malignancy) gave 75 "cures," or 39 per cent; and 110 Grade III (high malignancy) cases, gave only 14 "cures," or 13 per cent.

The conclusion is thus justified that the degree of malignancy of the tumor is of considerable significance in prognosis; and that this factor, in addition to that of the extent of the disease, should be given due consideration in estimating the probability of cure of cancer of the breast.

From 1917 to 1926 prophylactic X-ray treatment either pre-operative or postoperative, or both, was employed in 254 of the cases of radical operation. The dosage of X-ray given in those years, however, was much more superficial and undoubtedly less effective than that in use today. No material difference in the percentage of 5 year "cures" could be determined between the 254 radiated and the 120 non-radiated cases. X-ray cases gave 35.4 per cent "cures" and those without X-ray 35.8 per cent. The conclusion appears, therefore, to be justified that early and radical surgery is the most effective treatment for operable cases of cancer of the breast.

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*References numbers 4 and 5 to the New England Journal of Medicine, 1933, ccix, page 791, refer only to the published program of the New England Surgical Society, at which these two papers were read in September, 1933. They are now in the hands of the New England Medical Journal but have not as yet been published.

CANCER OF THE BREAST

MALVERN B. CLOPTON, M.D., F.A.C.S., St. Louis

THIS report is on 197 cases of cancer of the breast treated by radical operation at Barnes Hospital. All of the patients have been traced and all of them were operated upon between 1912 and 1933. There were 2 males in this series. The proportion of married to single females was 5 to 1. The largest number of patients was found in the decade between 40 and 50 years of age. Previous disease of the breast, presumably benign, was associated with cancer in about 8 per cent of the cases. Cancer was bilateral in 24 patients. No evidence was found that patients presented themselves for treatment any earlier in the last 10 than in the preceding 10 years. The total number of cases of breast cancer treated at the hospital during this period was 354; 93 per cent of these have been traced.

I shall report statistics from the group of patients operated upon by radical measures, which is the Halsted method, over 5 years ago. Of these cases 126 were traced: one-third had the disease confined to the breast, and in two-thirds the cancer had advanced beyond the breast involving the axillary glands, and in many cases the skin and other structures; so that in this group about one-fourth of the patients were considered unfavorable before operation. Of the 37 cases with the disease in the breast alone there were 24 living and well 5 years after operation, 64 per cent, and 10 lived over 10 years, 27 per cent. In 89 cases the cancer extended beyond the breast. Of these 27 were alive and well 5 years, 30 per cent; and 8 cases lived over 10 years after operation, 9 per cent. Grouping the two classes into one there were 126 cases of which 51, or 40 per cent, were living and well 5 years, and 18, or 14 per cent, living and well 10 years after operation. One each lived 21, 18, 17, 16, 15, 14 years, and 6 lived 13 years after operation.

It has been remarked by others that the statistics from various clinics vary very little. The figures I present are similar in all respects to those from our colleagues. The operations were performed by numerous operators, and none seemed to have better results than his fellow. All the staff used the clean dissection methods taught by Dr. Halsted except that skin grafting was not resorted to as often. The mortality in the 197 radically operated upon was 3.5 per cent, most of the deaths (6) coming in the unfavorable class of cases. Only 1 death occurred in the 66

CANCER OF THE BREAST IN BARNES HOSPITAL

	Cases	Per cent
Total cases	354	
Traced	321	93
Recurrence after radical operation elsewhere	24	
Recurrence after incomplete operation elsewhere	11	
Treated primarily at Barnes Hospital	286	

	No X-ray therapy	X-ray therapy
Group A—Cancer limited to breast—66 cases		
Alive and well after radical operation—40 cases		
For 1 year	4	3
For 2 years	1	4
For 3 years	3	4
For 5 years	3	3
For 7 years	3	2
For 10 years	3	
For 13 years	1	3
For 15 years	2	
For 21 years	1	
Total 5 year cases in radical treatment group—21 cases		
Known dead after radical operation—22 cases		
Lived less than 1 year	3	
Lived 1 year	2	3
Lived 2 years	2	4
Lived 3 years	0	2
Lived 5 years	1	0
Lived 7 years	3	0
Lived 8 years	1	0
Lived 10 years	0	1
Five year cases—7 cases		
Alive with disease after radical operation—1, 3 mos.; 1, 1 year		
Dead—date unknown, 2 cases		
Group B—Cancer involving axillary glands or beyond—131 cases		
Alive and well after radical operation—26 cases		
Lived 6 mos		1
Lived 1 year	3	2
Lived 2 years		1
Lived 3 years	1	2
Lived 5 years	3	2
Lived 7 years	1	4
Lived 10 years	1	1
Lived 13 years	1	1
Lived 16 years		1
Lived 18 years	1	
Five year cases—16 cases		
Known dead after radical operation—93 cases		
Lived less than 1 year	12	9
Lived 1 year*	10	16
Lived 2 years	7	14
Lived 3 years	5	11
Lived 5 years	1	1
Lived 7 years		2
Lived 10 years		3
Lived 13 years	1	
*Supraclavicular—with X-ray—1 case, lived 1 year		
Five year cases—8 cases		
Alive with disease after radical operation—1, 3 years; 1, 6 years; 1, 11 years		
Dead, date unknown—8 cases		
Group C—Simple mammectomy for advanced cases—33 cases		
Alive and well—2		
16 years, 1 case		
7 years, 2 cases		
Deaths—2		
5 years after operation—1		
7 years after operation—1		

Radical operations between 1912 and 1928	Cases	Per cent
Total cases	126	
Breast only involved	37	
Living and well 5 years	24	64
Living and well 10 years	10	27
Breast and axilla involved	89	
Living and well 5 years	27	30
Living and well 10 years	8	9
Total living and well 5 years	51	40
Total living and well 10 years	18	14
Living 13 years—6; living 14, 15, 16, 17, 18, and 21 years—1 each	12	

cases where the disease was limited to the breast. X-ray treatment has not been used routinely either before or after operation. Only about half the cases received X-ray treatment. It is our opinion and also the opinion of the radiologist, Dr. Sherwood Moore, that it cannot be said that radiation has prolonged life or prevented the incidence of recurrence, nor can any harm be said to have come from radiation. Visible local recurrences were occasionally favorably affected by radiation, seeming to be temporarily arrested. In an occasional inoperable case radiation seemed to have a favorable influence by reducing the size of the tumor and metastases. Radiation of skeletal metastases showed at times a tendency to heal the bony defect and to give relief from pain.

It is our impression that adenocarcinoma gave the most favorable outcome. Our cases were not all studied in regard to the cell classification of Broders. Cases that come in late to the hospital must necessarily give us poor prognosis. In my own private series I have been fortunate in seeing many cases early and the result has been that over 50 per cent are alive and well 5 years after operation. Many of these patients had no axillary involvement and diagnosis was impossible until the nature of the growth was revealed at operation.

CARCINOMA OF THE BREAST

Surgical Treatment and Results Five, Ten, and Fifteen Years After Radical Amputation

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THIS paper is a continuation of the one presented by one of us (Harrington) before the College last year. The cases in this study include 2,257 reported on at that time, 958 of whom were living 5 years, and in addition the cases in which operation was performed in 1926 and 1927. That is, the statistics are based on a series of 2,656 cases of carcinoma of the breast in which operation was performed between 1910 and 1927, inclusive. This permits a study of the results of surgical treatment over a period of at least 5 years in all 2,656 cases (Table I).

The signs and symptoms that are present in malignancy of the breast vary widely in specific cases. Fixation of the skin over the tumor has been considered to be one of the most characteristic clinical signs of the disease. One of the chief reasons for delay in seeking advice regarding the tumor or change in the breast is that it is rarely accompanied by pain. Often the visit to the physician is put off until the lesion has ulcerated and infection imposes a disagreeable condition. A review of the cases will show that in about 8 per cent the lesion has ulcerated either because of inadequate attention or because of delay in seeking competent advice. It has been estimated that in three-fourths of the cases in which there is fixation of the skin over the tumor, metastasis will also be present. The likelihood of extensive spread of the disease is still greater if ulceration has taken place.

Present clinical methods are inadequate for making a diagnosis of carcinoma of the breast with absolute accuracy until the disease is fairly well advanced. Many times the patient does not know that a tumor is present in the breast until it is recognized by a physician in the course of an examination for some other condition. Frequently involvement of lymph nodes already has taken place. This shows how impossible it is to judge the duration of the disease from the time the tumor was discovered. The presence or absence of involvement of lymph nodes is the only definite indication of the duration of the lesion.

Because malignancy cannot be recognized by the signs and symptoms in all cases, it will be necessary of course in some cases first to excise the growth for microscopic study in order to arrive at the correct diagnosis. If carcinomatous change is found, then complete radical amputation of the breast should be performed immediately. This will include removal of all of the lymph nodes along the upper portion of the brachial vessels, the axillary and sternal lymph nodes, and the lymph nodes that lie along the lateral thoracic wall, both above and below the axillary blood vessels, to a point at which the axillary vein becomes the subclavian vein. Adequate treatment, then, includes removal of the breast, the subcutaneous tissue, the axillary nodes and node-bearing fascia, the pectoralis minor muscle, and the greater portion of the pectoralis major muscle. The importance of early recognition of the disease and thoroughness in this operative procedure cannot be overestimated.

The most significant factors influencing the results of surgical treatment are the grade of the malignant process, the extent of involvement at the time of operation, and the thoroughness with which the radical amputation is carried out at the time of the primary operation. Experience shows that many times the disease has been allowed to progress while other forms of treatment have been tried; perhaps a conservative operation has been done. Therefore, the importance of complete radical operation, in the beginning, stands out even more clearly than when the former study was made.

In the study of 2,656 cases, the lymph nodes were involved in an average of 64.6 per cent of cases at the time of operation. With extension of the disease in such a large proportion of cases, it is evident that the patients are not coming for attention sufficiently early to obtain the best results from operation. Unfortunately, the percentage of patients with involvement of lymph nodes at the time they come for treatment is not decreasing. A conservative estimate shows that fully 70 per cent of patients operated on in the clinic during the last year had carcinomatous tissue in the lymph nodes as well as in the breast. Undoubtedly the present economic situation is partially responsible for the delay in seeking attention.

Each year, in the course of physical examination carried out as a routine, several women with carcinoma of the breast are encountered who had no knowledge of the presence of a growth, although

in some cases the disease may have made considerable progress. The only way that we shall ever be able to treat a greater proportion of the patients early in the course of the disease is to recommend a physical examination yearly, keeping in mind especially investigation of the mammary gland.

The percentage of the various grades of carcinoma of the breast approximates closely that of the four grades of carcinoma of other organs. However, we have learned that the same careful attention to detail in carrying out treatment may result in a considerable period of palliative relief if not of cure, even if extensive, active carcinoma is present. At least 11 per cent of the patients with carcinoma, graded 4, and with involvement of lymph nodes, will live 10 years after careful radical amputation of the breast. If extension by way of the lymphatic structures had not taken place by the time of operation, 38 per cent would have lived 10 years. This knowledge has made us more courageous in our attempts to obtain favorable results for patients with evidence of an extensive malignant process, and often they have had many additional productive years of happy life. For this reason the discouraging attitude maintained by many physicians will be unwarranted in the future. Although it is true that better results than were expected were secured in some cases in which extensive involvement of the lymph nodes was present, it is also certain that if operation had been performed early in the course of the disease the percentage of patients living several years would have been higher, and some of them undoubtedly would have obtained permanent cure. Although patients are not presenting themselves for treatment early enough, our educational effort is bearing some fruit, for at least there is wider recognition of the menace of a tumor in the breast.

TABLE I.—RADICAL AMPUTATION IN 2,656 CASES OF CARCINOMA OF THE BREAST (1910 TO 1927 INCLUSIVE)[1]

(Percentage of cases with involvement of lymph nodes, 64)

	Results of operation					
	Living 5 years		Living 10 years		Living 15 years	
	Patients	Per cent	Patients	Per cent	Patients	Per cent
With involvement of lymph nodes	461	26	149	13	52	9
Without involvement of lymph nodes	673	71	317	55	126	40
Total	1134	42	466	27	178	20

[1]Each percentage is based on a different quantity, not expressed in the table. Example 1: 461 is 26 per cent of 1,718. The last figure (1,718) represents the number of patients with involvement of lymph nodes whose operations were performed at least 5 years before the study was made. Example 2: 149 is 13 per cent of 1,146. The last figure (1,146) represents the number of patients with involvement of lymph nodes whose operations were performed at least 10 years before the study was made.

That progress has been made in treatment of the disease is evident. In our recent study of 2,656 cases of carcinoma of the breast of all grades, 1,134 of the patients were living 5 years after operation, 466 were living 10 years after operation and 178 were living 15 years after operation. This experience amply substantiates the contention that carcinoma of the breast is curable.

FIVE YEAR CURES IN A SERIES OF FIFTY-FOUR BREAST CANCERS

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THIS paper analyzes, in relation to 5-year cures, a series of 54 breast cancers which were treated at St. Vincent's Hospital, Birmingham, Alabama, during the years 1922 to 1928 by Doctors Cunningham Wilson, Earle Drennen, S. L. Ledbetter, Jr., B. S. Lester, and myself, of the surgical staff, with the addition of a few cases which were operated on by other surgeons who occasionally visit this hospital.

In practically every instance these were private patients of the class whose general information and intelligence would direct them, one would suppose, to seek prompt relief for any condition which suggested the possibility of malignancy; thereby differing greatly from that great army of cancer patients of less intelligent type who present themselves at our public clinics only after the disease is hopelessly advanced. It is lamentable, however, that many of the better informed and more intelligent do not seek early relief; and this is conclusive evidence of the necessity for the vigorous campaign of education which is being carried on by The American College of Surgeons in its endeavor to inform the public that cancer is curable if recognized and removed at an early period.

TABLE I

	Cases	Per cent
Total cases	54	
Number traced	46	
Percentage traced		85.1
Alive and well at the end of 5 years	30	
Percentage of 5-year cures		55.7
Known dead at the end of 5 years	18	
Lost sight of and classed as fatalities	6	
Treatment		
By radical operation	49	
Five-year cures	29	
Percentage of 5-year cures		59.18
By incomplete operations and palliative measures	5	
Five-year cures	1	
Percentage of 5-year cures		20.

TABLE II.—INCIDENCE OF THE DISEASE AND MORTALITY BY DECADES

Ages in years	Number	Deaths	Mortality rate
20–30	1	1	100
30–40	14	7	50
40–50	15	9	60
50–60	10	4	40
60–70	10	1	10
70–80	1	0	0
Not given	3	2	

	Cases	Per cent
Patients under 50	30	
Deaths	17	
Mortality		56.6
Patients over 50	21	
Deaths	5	
Mortality		23.8

Every case has been subjected to careful microscopic study and we feel confident of the correctness of each diagnosis. Radiation was not employed to any extent in this series, hence its value as an adjunct to surgery will not be discussed here. It is realized that the number of cases reported is too small to be of statistical value if considered alone, but the facts which have been revealed by the analysis are in keeping with observations which have been made in other clinics and are in direct confirmation of conclusions which have been drawn from larger series by other reporters.

Since passing the 5-year period some patients have died of intercurrent disease and a few from late recurrence, while many are alive and have remained free from evidence of return for periods of from 6 to 11 years.

A gradual reduction in mortality in the older as compared with the younger ages is noted in Table II. This becomes more evident when we compare the cases under 50 with those over 50 years of age. The ages of 3 patients are not recorded.

The longer a cancer exists untreated the more likely are glandular metastases to be found at operation. The mortality in cases with glandular metastases is much greater than in those in which this change has not taken place. In 13 instances the condition of the lymph nodes is not recorded (Table III).

Local excision of small malignant tumors is, as a rule, to be condemned, for in just such cases should we expect the surest cures to follow radical operation (Table IV).

TABLE III.—MORTALITY BEFORE AND AFTER GLANDULAR INVOLVEMENT

	Cases	Per cent
Lymph nodes were involved at operation in	27	
Deaths	17	
Mortality		63.
Lymph nodes not involved in	14	
Deaths	2	
Mortality		14.28

TABLE IV.—INCOMPLETE OPERATIONS AND PALLIATIVE MEASURES

	No.	Recovered	Died
Palliative mastectomy	1	0	1
Extensive ulceration from "cancer paste" Inoperable.			
Non-operative	1		1
Lung and pleura involved on admission; aspiration of chest			
Excision of tumor	3		
Small nodules showing early malignancy.			
Total	5		
Mortality, 80 per cent.			

CANCER OF THE BREAST—A CURABLE DISEASE

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CANCER of the breast is curable when found and attacked early enough, provided it be attacked with all the measures now known, and that these weapons are employed by those competent to use them. In the light of what is now known this statement is hardly debatable and is almost axiomatic.

There are two phrases used in the above that may be taken for the text of my remarks:

1. "Early enough"—the cancer must be early and by early I mean before the base, the midaxillary and the apical axillary glands are involved.

2. "The measures"—the operation must be radical and the adjuncts, radium and X-ray, must be timely, strategically, and intelligently employed.

In the few minutes at my disposal I shall endeavor to confine my remarks to these texts, and confess that, in the light of our standard textbooks and the literature, they may at times seem dogmatic.

If one reads of the symptomatology and signs (early) as they appear in the standard works and the literature of our distinguished authorities one cannot help but be impressed with the striking similarity of presentation found in all, and where does one read that the only discoverable sign of cancer of the breast is a lump?

One may talk glibly about retraction of the nipple, changes in pigmentation, shortening of Cooper's ligaments with its concomitant pig-skin appearance, transillumination and shadow test, fixation, and glands in the axilla, but in so doing we are discoursing on late cancer. A lump in the breast presenting these signs is cancer; in the absence of these signs we must defer diagnosis until removal and microscopic section (frozen section).

Those of us who have seen early cancer of the breast have seen it largely by accident in the removal of a small lump previous to operation thought benign, and only on careful section found it to be cancer. These are usually small areas found in either the base of a papillomatous cyst, an adenomatous tumor, or in gland or duct epithelium.

The diagnostic, or better say, the guessing ability of those who propose to differentiate between benign and early malignant lumps of the breast is open to serious question. One of our most distinguished surgeons, a great teacher, said last year when contributing to the cancer symposium, "In the present state of our knowledge, there can be no possible excuse for failure to recognize cancer of the breast." When? At what stage? Only when the growth is fairly well advanced. Does he mean there can be no excuse for not taking out the lump and having it diagnosed by a competent pathologist, or does he mean that it should be done without this? What are the signs of early cancer? Only one sign, a lump in the breast. How can the lump be differentiated with a fair degree of assurance? Only by removal and frozen section. Yes, there is another method. What is it? Wait until the unmistakable signs of cancer are present, then by the rote repeated methods as are now too frequently taught we may with confidence arrive at a diagnosis of cancer but with decidedly less confidence approach the operating table and anticipate a cure.

With the impetus given to patients through educational movements, the lay magazines, etc., portraying the signboards of danger, we are seeing cancer earlier than ever before. The first problem we must answer when these patients present themselves is,—Is there a lump? We are seeing a great number of people who think they have a lump but in whom no lump is found or who have chronic cystic mastitis.

Granted there is a lump we have avoided procrastination until unmistakable signs of cancer appear, signs which by their very nature are late, and, to quote from Caesar, we have chosen rather to "think him as the serpent's egg which hatched might as his kind grow mischievous and kill him in the shell."

Much has been written about precancerous lesions of the breast and other organs, yet no one seems to have seen the exact beginning of malignant change in the cells of what is called a precancerous lesion. Even our foremost pathologists are often entangled in lengthy discussions pro and con malignancy in lumps removed from the breast, but when the growth has been removed and has been treated as though it were malignant, the patient lives free from the disease.

It would seem to me high time to abandon many of the traditional, differential, diagnostic signs of advanced cancer, and teach fairly and truthfully that any lump in the breast is abnormal; that in these lumps we are entirely unable by any method except microscopic sections to determine the presence or absence of malignancy.

TABLE I.—BREAST CANCER, 83 CASES

Without metastasis		36
Refused therapy	2	
Living, 4 years (too recent)	3	
Living, 5 years	20	
Dead	5	
No follow-up	6	
Percentage, 5 year cures	71	
With metastasis		47
Refused therapy	1	
Hopeless, all dead	30	
Living, 5 years	6	
Dead	7	
No follow-up	3	
Percentage, 5 year cures	46	
Percentage 5 year cures group—complete operation plus radium	77	

TABLE II.—BREAST CANCER, 36 CASES, NO METASTASES

	Cases	Living 5 years	Dead	No follow up
Complete operation	4	2	1	1
Complete operation plus radium	19	14	4	1
Complete operation plus X-ray	4	2	0	2
*Complete operation plus radium-X-ray	7	2	0	2
Therapy refused	2			

Percentage cures for group 71
Percentage cures for group receiving radium 77
*3 living—4 yrs. 8 mos., 4 yrs. 2 mos., 4 yrs. respectively (too recent).

That when we have waited until there is retraction of the nipple, shortening of Cooper's ligaments, *peau d'orange* or pigskin appearance, or glands in the axilla, we are dealing with necessarily late cancer, and have lessened thereby very materially the patient's chances for recovery. Certainly many tumors of the breast are nonmalignant growths, and if left alone would possibly remain simple, but we must deal with early cancer to obtain our objective of a 100 per cent recovery.

Of course, we all are aware that there are certain conditions that produce lumps in the breast, usually both breasts, and we can say more or less positively that they cannot be cancer, yet here again one must be guarded.

The teaching for years has been that lumps in both breasts are benign, usually chronic, cystic mastitis and therefore operation is not indicated. To make us somewhat fearful of accepting this dictum 4 cases appeared in our series with lumps in both breasts, one or both of which were malignant.

Now as to the second phase of our text—"Measures." The complete removal of any cancer will result in cure whether early or late. The difficulty we encounter all too frequently is that the cancer has often advanced to such extent and proportion that we cannot circumvent it. We possess no means of eradication. Our records show that many patients after the discovery of the lump wait for long periods before consulting a physician and, lamentable indeed, oftentimes after they have consulted a physician a prolonged period intervenes before the advice of a competent surgeon is sought. It is essential to get these cases early.

In the light of our best knowledge what are the means or measures we have found best to employ—(1) surgery, (2) X-ray and radium?

The scalpel still remains our best weapon in dealing with malignancy of the breast, and X-ray and radium must still be regarded as the handmaids of surgery in dealing with this oftentimes hopeless disease. I feel strongly that their combined use will give us better results in dealing with the breast than can be achieved by either weapon when used alone. Surgery in the very advanced cases should be replaced by radium and X-ray. There is still some discussion among surgeons as to how best to remove a lump for diagnosis. The cautery knife would seem preferable to the scalpel. Plan a conservative operation until the true nature of the growth is determined by frozen section. If malignant, proceed to do the complete operation. When the operation is completed implant radium at all strategical points not after, but as part and parcel of, the operation.

My proposal of this method was made in 1922. It was later advocated by Handley, in 1928, and has since been employed by Trout, Wainright, and others. The plan followed then made it possible to give thorough radiation throughout the operative field. I now believe it is better to implant many one or two milligram platinum needles at strategic points within the operative field, leaving them in for a longer period of time, rather than the heavier ten milligram needles for the shorter period.

Where the growth is definitely a cancer, preoperative radiation by a competent roentgenologist should be done. The operation should follow within 2 to 3 weeks with the radium implanted as indicated, at the time of operation. I strongly advise postoperative radiation with X-ray as a part of the treatment in all cases which show any glandular involvement. In the very advanced cases, that is hopeless cases, with metastases to bone, to lungs, or mediastinum, X-ray and radium should be relied upon and no operation done. The tangential method of X-ray radiation is the one of choice. The question might be raised, why,

in an early case of cancer, a small tumor which is freely movable and completely removed by the scalpel, place radium in the operative field? Just to "kill the coon 'deader.'" In our experience the size of the lump gives no definite information as to the extent of the growth. The lymphatics may be microscopically involved and not grossly. The growth may have extended further than the surgeon's knife or cautery. We know that radium will destroy cancer cells when properly administered, and particularly is this true when the needles are placed in the midst of, and within range of, the cancer cells.

Reports which soon are to appear from those using radium as part and parcel of the operation are, we feel quite confident, to reveal a higher incidence of 5 year cures. The literature now appearing in the journals indicate a much wider use of this method.

A brief review of 83 cases coming under our care since this method has been employed gives us the following results. In those patients presenting themselves with cancer of the breast and no metastasis to the glands of the axilla either basal, midaxillary, or apical, 77 per cent are now living after 5 years. To the best of our knowledge 71.8 per cent represents the best results that have thus far been achieved by the scalpel alone. In those patients who had, in addition to cancer of the breast, involvement of the glands of the axilla either basal, midaxillary, or apical, 50 per cent are now living after 5 years. This would show then that nearly twice as many patients who had glands involved are living after 5 years when radium has been employed.

TABLE III.—BREAST CANCER, 47 CASES, WITH METASTASES

	Hopeless	Not hopeless
Number of cases	30	17
Living 5 years	0	6
Dead	30	7
No follow-up	..	3
Refused therapy	..	1
Percentage 5 year cures in group with metastases—not hopeless	..	46

In the group of cases which we have regarded as hopeless and have included in our hopeless cases those patients presenting supra-clavicular glands, mediastinal or lung metastasis, and cases which have metastasis to the bone, the average duration of life when untreated is 9½ months. The hopeless cases treated with X-ray or radium or both have an average duration of 18 months. From this group of cases, small though it is, it would appear that radium as a part and parcel of the operation is definitely an advance over the knife alone.

In conclusion:

1. It is advised that all single lumps of the breast be removed to determine exactly their nature.

2. The use of radium in conjunction with a radical operation as part and parcel of the operation is advocated.

3. A brief résumé of 5 year cures is presented.

RESULTS OF RADICAL OPERATION FOR CARCINOMA OF THE BREAST

RICHARD R. SMITH, M.D., F.A.C.S., GRAND RAPIDS, MICHIGAN

FROM 1898 up to the present year Dr. Henry J. Vanden Berg and I have operated upon 267 patients with primary cancer of the breast. Of these, 205 were operated upon previous to the year 1928, or more than 5 years ago. Of the 205 cases, we have been able to trace all but 3. The list is unusual in that we have been able to trace so large a percentage of our cases and this, together with the fact that the experience covers a good many years, gives us a fairly accurate idea as to what becomes of patients suffering from this disease. The pathological material of all living patients has been reviewed, and the diagnosis reaffirmed. We excluded from this report 8 cases in which pathologists disagreed as to the diagnosis. We would have liked to have included them for they would have helped our statistics. In some of our earliest cases no pathological examination was made, and in a few the material has been lost. We have included them among our deaths where there was recurrence, but have not included them in the list if they are now living and well. Two died hospital deaths following operation and were included among the deaths from recurrence.

Of the 202 traced cases, 140 are dead with or from recurrence of the disease; 40 are living and well with the exception of 1 doubtful case operated on 21 years ago who now has abdominal symptoms suggestive of cancer; 22 have died without manifestation of the disease.

We have divided our cases into three general groups. Those without axillary metastases, those with axillary metastases, and those in which the disease had advanced so far as to leave but little hope of being able to eradicate it. In other words, the operation was more or less palliative. In the first group of 53 patients we have 23 living and well, 43.4 per cent; in the second group of 94 patients we have 16 living and well, and the 1 doubtful case, 18.1 per cent; and in the third group of 58 patients we have none living. The classification of Broder could not be applied to our list since it is a recent development.

Of the 140 patients who have died of recurrence, 114 have died within 5 years, 81.4 per cent; and 26 in periods varying from 6 to 19 years, 18.6 per cent.

Our patients who are living after 5 years and are free of manifestations of the disease are 40 including the 1 doubtful case. The period varies from 6 to 25 years. Those dying without manifestations of the disease are 22 and the time has varied from 1 to 17 years.

Of our 202 cases 75 were alive, with or without manifestations of the disease, at the end of 5 years following operation; 114 were dead of or with recurrences; and 13 had died without manifestations of the disease from other causes.

The length of time elapsing between the time when the patient first noticed the tumor and the time in which she reported for operation is important. We all believe that patients are reporting earlier than formerly and stress this in order to obtain better results. If we take the average for any one period it tells us little since 1 or 2 patients who have reported after many years spoil the averages for that period. I therefore took those in each 5 year period from 1898 to 1932 who had reported in 2 months or less, and the percentage of those so reporting in the 196 cases in which the time is stated in the history was as follows:

1898—1902,	none	1918—1922,	27.3 per cent
1903—1907,	12.5 per cent	1923—1927,	41.3 per cent
1908—1912,	14.3 per cent	1928—1932,	45.9 per cent
1913—1917,	16.6 per cent		

This shows pleasing progress as the result of better education of the public and profession, but still leaves an appalling number who consult the surgeon too late, and indicates that our efforts in public education should not be relaxed but that we should go ever forward with them.

CARCINOMA OF THE CERVIX UTERI

Report of Five Year Cures by Radium in British Hospitals

H. BECKWITH WHITEHOUSE, M.S. (Lond.), F.R.C.S., F.C.O.G., Birmingham, England

IN presenting my contribution to this important discussion upon the curability of cancer, may I congratulate this College upon the action that it has taken. The very title of the symposium "Cancer Is Curable" infuses a spirit of optimism into those of us who live almost daily among cancer patients, and cannot be other than stimulating to the general medical profession, and, above all, to the great lay public for whom we work. Our deliberations today will, I trust, be the means of transmitting to the world at large a ray of hope upon a problem which for so long has been shrouded with gloom and disappointment. The knowledge that cancer is a curable disease is perhaps the greatest contribution that the medical profession can hand to the public at the present time when world statistics show that the scourge is on the increase.

In the preparation of my report I have deliberately restricted investigation to one aspect, viz., the permanent cure of carcinoma of the cervix uteri by means of radium. I have had before me not only the figures from my own clinic, but also those from 5 other leading research centers in England and Wales as collated by the Medical Research Council of Great Britain. The hospitals which have furnished the material analyzed are St. Bartholomews, University College, The Middlesex, and the Marie Curie, in London; the General Hospital, Birmingham; and the Royal Infirmary, Cardiff. The total number of patients treated with radium for cancer of the cervix uteri in these clinics between 1921 and 1926, inclusive, is 507. Of these women, 56 were alive and well at the end of 5 years or longer, giving an absolute curability rate of 11 per cent.

In Table I is presented an analysis of these "5 year cures" into "Incipient," "Borderline," and "Inoperable." The most striking feature is the inclusion of 26 cures—almost 50 per cent of the total—among patients who were classified clinically as advanced cases and inoperable.

TABLE I

Year	Interval since irradiation Years	Incipient	Borderline	Inoperable
1921	10	0	1	0
1922	9	1	0	0
1923	8	3	0	0
1924	7	3	0	3
1925	6	5	4	8
1926	5	8	5	15
Total		20	10	26

Table II is a statement of "5 year cures" in relation to the total number of cases treated in each group during the period under review. The figures in this table emphasize in no uncertain manner the importance of treatment in the early stages of the disease. The first point to which I call attention is that out of a total of 507 patients only *34 sought treatment when the disease was in the incipient stage.* The borderline cases, numbered 86 and *387 were hopelessly inoperable.* Note also that of the 34 early cases *20 women were alive and well at the end of 5 years* or longer, a percentage curability rate of 58.9. Compare this with the figures of 6.7 per cent and 10.6 per cent in the case of the inoperable and borderline patients. The total curability rate of 11 per cent for the whole series is thus influenced adversely by the inclusion of the great inoperable group.

When we think that if cancer of the cervix uteri is treated with radium during its early stages it is possible to obtain a permanent cure in more than half of the total cases, is it not deplorable that a little over 75 per cent of women suffering with the disease apply for relief when we can offer them the possiblity of only a 6 per cent cure?

The figures that I have the honor to submit for your consideration prove beyond doubt that cancer of the uterus is curable in its earliest stages. The total curability figures, however, are not likely to be improved without better co-operation between the general public and the medical profession to ensure the earliest recognition and treatment of the disease.

May I in conclusion utter a plea for improvement in the investigation and treatment of the precancerous cervix? The lacerated and chronically inflamed cervix, so often a neglected legacy of childbirth, is a condition fraught with the greatest danger and I should like to see every one of those lesions adequately treated. It is good to treat cancer and cure it, but it is better still to prevent it!

TABLE II

	Cases	Per cent
Total number of incipient cases treated 1921–1926...	34	
Percentage of cures on 5 year basis.....		58.9
Total number of borderline cases treated 1921–1926..	86	
Percentage of cures on 5 year basis.....		10.6
Total number of inoperable cases treated 1921–1926..	387	
Percentage of cures on 5 year basis.....		6.7
Total curability, 507 cases	56	11.0

FIVE YEAR RESULTS IN THE TREATMENT OF PELVIC CANCER

BROOKE M. ANSPACH, M.D., F.A.C.S., PHILADELPHIA

FROM September, 1921, to September, 1928, 114 cases of *cervical carcinoma* were admitted to the Gynecological Ward Service of the Jefferson Hospital. Of this number 104 remained for treatment; in 10 cases the patients were not treated either because the lesion was too far advanced or because the patient was unwilling.

Of the 114 cases, 14 or 12 per cent were Class I and II (Schmitz), only 2 cases (1.7 per cent) falling into Class I; 81 cases, or 71 per cent, were in Class III; 16, or 13.6 per cent, were in Class IV, while 3 cases, or 2.6 per cent (first treated elsewhere), were in Class V.

The follow-up clinic has accurately traced 88.5 per cent of the total number, and 92.3 per cent of those actually treated. All untraced patients are regarded as having died from cancer even though when last seen they had no sign of a recurrence. With greater care in the follow-up clinic there are now no untraced cases since September 1, 1928. Of the 114 patients applying for treatment, 20 are now (September 15, 1933) alive and well, a present day absolute curability of 18.4 per cent.

A distinction may be drawn between the so called 5 year cures and the present day cures, since some of the patients apparently free of cancer at the end of 5 years have a recurrence later. In a 5 year classification we have 5 more patients who apparently were cancer-free at the expiration of that time, so that our 5 year absolute percentage is 21.9. Of the patients treated (104), our present day curability which we may speak of as relative, is 19.2 and our 5 year relative curability is 24 per cent.

The cases have not been listed routinely as to cell type except in recent years, but we have been able to review the histological sections in 20 of the 5 year cures. Our pathologist, Dr. Baxter L. Crawford, employs the simple classification of low grade, intermediate, and high grade malignancy. Most of our cured cases were of the intermediate group. So far as we have gone it is our inclination to believe that prognosis from cell type alone is of limited value, the outcome depending fully as much upon the duration and extent of the lesion and the resistance of the patient.

As a result of this experience with the radiation treatment of cancer of the cervix, and in view of the unexpectedly good results in cases that appear unfavorable, and the late recurrences in a definite proportion of cases, we ask ourselves whether, with improved technique, greater things might be accomplished. In other words, is it possible by more attention to the individual case and to the choice and disposition of the radiation to improve the results?

Theoretically at least X-ray treatment comes up for consideration as an important preparation for radiation with radium of cancer of the cervix, in order to affect the cells lying outside the cervix and beyond the reach of radium implanted there. As a matter of fact, however, in the early cases (Class I and II) there may be no cancer cells beyond the influence of radium and some authorities believe that the possible harm accruing from the X-ray saturation of normal tissues may more than equal the possible good (Stone). Given immediately after the implantation of radium, deep X-ray therapy may be objectionable for the same reason, and used some time after, in our experience, it has seemed harmful rather than beneficial. While therefore deep X-ray therapy cannot be adopted routinely and seems to be of questionable value as an adjuvant to radium, especially in the earlier cases (Class I and II), it is certain that the immediate use of radium in widely extended cervical cancer, and especially the infected and sloughing one, should be limited. Here the X-ray primarily is safer and, except in very fat women, very satisfactory, sometimes being all that is required for regression of the growth and a subsidence of symptoms, or at least providing a more favorable field for the radium.

There are certain points in the technique of the application of radium to the cervix that, so far as our own experience goes at least, we are anxious to improve. Up to the present we have been limited in our work to the use of 25 and 50 milligram capsules of radium screened with .3 millimeter of silver or 1 millimeter of brass encased in 2 millimeters of black rubber and 12.5 milligrams of radium needles screened with .3 millimeter of Monel metal. The dose has ranged from 2400 milligram hours to 4800 milligram hours; the average now is 3600 milligram hours. We have re-radiated lesions in two of the patients now presumably cancer-free, bearing in mind the need of a limited dose. We are of the opinion that it is very desirable to have at hand radon in seeds and in a bomb to use as the occasion requires. The exact disposition of the radiating

substance, the dose, and the form in which it can be most accurately placed is often more definitely revealed after the patient is under anæsthesia.

We venture the suggestion that the capsule of radium placed in the cervical canal should reach definitely above the limits of the cervix or, indeed, if there is any gross involvement, two capsules should be used, filling the uterine cavity—and that enough radium needles or radon seeds or bombs should be at hand to radiate the entire periphery and the bulk of the growth thoroughly.

CANCER OF THE FUNDUS

From September 1, 1921, to September 1, 1928, 13 cases of fundal carcinoma were admitted and treated. Most of them were far advanced upon admission. Until recent years we thought that hysterectomy was the procedure of choice in fundal carcinoma. Four of the cases were subjected to complete hysterectomy, 1 of whom is now alive 8 years after operation; 3 died within a year; 1 lived 2½ years; and 1 lived for a year, then becoming untraceable.

In 2 other cases of proposed hysterectomy, exploratory section showed widespread metastases; the operation was abandoned and the cases were treated with X-ray. Both died within a year.

Seven cases were treated by radiation—5 received intra-uterine doses of radium varying between 2400 and 7200 milligram hours. One received X-ray only and was at the same time treated for cancer of the breast. She lived 3½ years. One case was treated with both forms of radiation. Following primary radium (2400 milligram hours) she had X-ray in 1926, 3600 milligram hours of radium in 1927, 4800 milligram hours of radium followed with X-ray in 1928. She is now living and well.

The two living cases of fundal cancer give an absolute and relative present day curability of 15.3 per cent. The follow-up represents 92.8 per cent.

Our plan of treatment during the past 3 or 4 years has been to have radium available at the time of diagnostic curettage in all suspected fundal cancer cases, placing it *in situ* immediately. The curettings are examined within 24 hours and the cell type determined. If cancer is present the radium is allowed to remain for 36 to 48 hours and subsequent X-ray radiation soon is made. The subsequent treatment depends upon the clinical factors of age, general condition, obesity, and the cell type. We would be inclined toward the plan of Healey in selecting patients for subsequent operation. We have not included private patients having cancer of the cervix or fundus in this report because we have been unable up to the present to complete our data. We plan to do so later. Our impression is that with cancer of the cervix our results are no better than we have had in the ward series. In cancer of the fundus, however, the results have been much more favorable.

CANCER OF THE OVARY

In this series we are able to include all cases, ward and private, treated in the Gynecological Service between September, 1921, and September, 1928. These number 24.

There are 7 cases now living and apparently well at the end of 5 or more years, a curability of 29.1 per cent; in 5 of the 7 cases, 17.24 per cent, there is no evidence on palpation of any pelvic disease. In 2 there are small masses or areas of pelvic induration without any abdominal, or pelvic symptoms. The patient apparently is cured but fibrotic tissue has been left behind.

We classify clinically our ovarian cancers as follows:

1. The disease is limited entirely to the ovary and completely removable.
2. The disease is mostly limited to the ovary but there is some spread that is removable with the ovary.
3. The disease is not limited to the ovary and there are spreads that are only partly removed.
4. The disease is widespread and completely inoperable.

In Class I—1 living 11 years, 2 dead, 1 untraceable, 1 living 4 years, and 1 living nearly 2 years.

In Class II—4 living more than 6 years.

In Class III—2 living, 1 living 7 years, and 1 living 11 years.

In Class IV—All dead within 1 year.

We have had 3 cases of ovarian sarcoma. Two are alive, 66.6 per cent of cures, 1 for 7 years and 1 for 11 years.

We have had 1 case of folliculoma malignum (Meyer)—a form of granulosa cell tumor, now living and well for 4 years and 5 months.

It is interesting to estimate the influence of postoperative X-ray on ovarian tumors, which is as follows:

In 5 of our living cases of cancer it has been used.

In 2 of our living cases of cancer it was *not* used.

In our 2 living cases of sarcoma it was *not* used.

We feel that it is a worth while adjuvant to operation but that its true influence is hard to

gauge because of borderline cases of carcinoma from the diagnostic standpoint, and because it is difficult to classify the extent of some cases of ovarian malignancy even though the abdomen is open.

We also wish to direct attention to the danger of deep X-ray treatment in these cases; we have had 3 deaths to which it seemed to contribute: 1 from agranulocytosis, 1 from colitis, 1 from overwhelming toxæmia.

FIVE YEAR CURES OF CARCINOMA OF CERVIX UTERI

HARRY S. CROSSEN, M.D., F.A.C.S., AND QUITMAN U. NEWELL, M.D., F.A.C.S., ST. LOUIS
From Department of Obstetrics and Gynecology, Washington University School of Medicine and Barnes Hospital

IN addition to the cases handled in the Gynecological Wards of the Washington University School of Medicine and Barnes Hospital, the series includes my private cases and those of Dr. Q. U. Newell, my associate in the teaching. To Dr. Newell belongs the credit for execution of the laborious task of tracing the patients and assembling the data from which reliable conclusions could be drawn.

This series of 5 year results includes the patients treated from 1921 to 1926. The series, with analyses and conclusions, was reported[1] to the American Gynecological Society in 1931. In every case the diagnosis was confirmed by microscopic examination of excised tissue. The clinical data and the laboratory reports and slides are on file in the Gynecological Department of the Medical School. We are now working on the analysis of the 5 year results for the additional 2 years, 1927 and 1928, but could not complete it in time for this meeting.

When reported in 1931, the series showed 27 survivals and 15 patients untraced. The untraced patients were counted as dead from cancer. Since then 8 of the 15 have been traced and 2 of them were found alive and well, which gives 29 cures in 121 cases (23.9 per cent). The original grouping of the cases was according to the Schmitz classification, but later they were regrouped according to the League of Nations international classification. This division into clinical classes according to the League of Nations classification is shown in the tables.

There are two striking features in the series reported. One feature is the very large percentage of advanced cases—there being only 14 cases in clinical Classes I and II. The other important feature, and a most encouraging one, is the obtaining of cures in some cases in which the deep involvement was very extensive.[2] The experience of seeing massive carcinomatous infiltration of the pelvis with firm fixation to the wall over a large area gradually melt away under careful irradiation with radium and X-ray encourages me to give every patient not in terminal condition the benefit of this possibility.

Statistical data are shown in the two tables. Table I indicates the number of cases in the different classes and the number of 5 year survivals in each class. In clinical Class I the cancer was apparently still confined to the cervix. In Class II there was parametrial involvement but the cervix was still somewhat movable. In Class III there was parametrial involvement to the pelvic wall with fixation of uterus. Class IV represents terminal conditions, with involvement of rectum or bladder or vaginal walls.

The table dealing with secondary radium treatments emphasizes the fact that if the maximum radium dosage permitted by the conditions be given at first, there will seldom be local recurrence at the vaginal vault or need for secondary radium treatments.

CONCLUSIONS

Present efficiency and future progress in preventing deaths from cancer of the cervix uteri are predicated on the following facts:

1. The successful care of a patient with cancer of the cervix is based upon an organized combination of expert services. It is the vigorous use and careful co-ordination of the best that can be secured in several lines that gives the full chance of stopping the malignant process.

2. The crucial point of attack is not the uterus but the cancer cells along the pelvic wall. It is these outlying cells that must be reached and destroyed, or recurrence is certain.

[1] Conclusions from a study of five year cures in a series of 121 cases of carcinoma of the cervix uteri. Am. J. Obst. & Gynec., xxii, 559–590.

[2] Cancer of the cervix uteri: some pertinent facts concerning the treatment. J. Am. M. Ass., xcix, 2149–2152.

TABLE I.—CLASSIFICATION OF CASES

Patients treated 121	Squamous-cell carcinoma	Adeno-carcinoma	Clinical classes			
			I	II	III	IV
	108	13	3	11	97	10
Survivals (5 to 11 years) 29	27	2	3	5	21	0

TABLE II.—SECONDARY RADIUM TREATMENTS

Patients treated 121	Squamous-cell carcinoma	Adeno-carcinoma	Clinical classes			
			I	II	III	IV
	108	13	3	11	97	10
Secondary radium treatment all patients	10	1	0	0	11	0
Secondary radium treatment survivals	1	0	0	0	1	0

3. Irradiation is the most important factor in attaining success in this concerted attack on the outlying cancer cells. There are exceptional conditions in which operation also may be advisable, but whenever used operation should supplement irradiation and not displace it.

4. Too many cancer patients are still being treated with half-way measures—with operations that never reach the outlying cancer cells, and with inefficient radium and X-ray treatments that carry no devitalization into the distant crucial zone.

5. Cancer of the cervix continues to take its high toll of lives in spite of the fact that methods of treatment have been developed to almost complete efficiency for the early stage. The difficulty in raising the average percentage of cures is due to the fact that patients do not come in an early stage, although there has been long and strenuous education as to early symptoms.

The patients do not come early because in the beginning cancer of the cervix is *symptomless*. In the really early stage there are no symptoms whatever. That is the great obstacle which blocks advance and has for years held the average of cures down to between 20 and 25 per cent, while patients with early growths can be cured in 90 to 100 per cent of cases.

Though it is imperative to establish the diagnosis at the earliest possible moment, dependence on early diagnosis for any marked increase in the percentage of cures will prove disappointing. Experience has clearly shown that in most cases of cancer of the cervix there is no warning sign whatever until the cancer spread has become extensive.

6. Further marked advance in the prevention of deaths from this form of cancer is blocked until there can be brought about widespread and systematic removal of those chronic irritative lesions of the cervix which precede cancer and cause it. Efforts to overcome this serious situation must take into consideration the following facts: Thousands of patients with chronic irritation in the cervix (cervicitis, laceration, eversion, "ulceration," erosion, polypi) are receiving palliative treatment, which may keep them comfortable but does not remove the deep chronic irritation favoring cancer development. Other thousands of women are treating themselves for a "little leucorrhœa" in ways that may relieve the discomfort but do not eliminate the lesion. There are still others in which the chronic irritation in the cervix does not give rise to any symptoms that would cause the individual to suspect local trouble. In the attempt to eliminate the chronic irritative lesions, means must be found for reaching these three classes of persons.

7. The prevention of cancer of the cervix by the detection and removal of chronic irritation is a many sided problem which demands vigorous and systematized action. I took up this problem in detail at this year's meeting of the American Gynecological Society and it is not necessary to review it here, except to emphasize that results depend on three definite steps by physicians, as follows: (a) the prompt removal of chronic cervicitis and allied lesions of the cervix when encountered in practice; (b) advice to patients as to the necessity of examination for the detection of such lesions, even when there are no disturbing local symptoms; (c) assistance in the campaign of public instruction in cancer prevention, particularly as to the advisability of examination for the detection of symptomless chronic irritation in the cervix that may lead to cancer.

8. Each physician has it in his power to give definite help in the general reduction of deaths from cancer of the cervix and in saving his individual patients from this disease—and to do so is not only a privilege but a serious duty. The surgeon, the internist, the general practitioner—every physician who assumes the responsibility of advising a patient in regard to her health—must keep in mind the possibility of symptomless cancer of the cervix or chronic irritation that may eventuate in cancer.

CANCER OF THE BODY OF THE UTERUS

WILLIAM P. HEALY, M.D., F.A.C.S., NEW YORK

IN cancer of the body of the uterus it is generally recognized that we are dealing with a form of cancer that tends to grow slowly and to remain localized in the uterus for a rather long time before spreading to other structures. Histologically it is glandular carcinoma arising from the endometrium. The average age of the patients is about 55 years. The uterus at that age has no function to perform and may be regarded as a useless organ. Therefore the natural tendency has been to attempt to cure the patient by doing either vaginal or abdominal hysterectomy.

The end-results of this operation were regarded as satisfactory until hospitals, under the direction and encouragement of the American College of Surgeons, established follow-up records of all surgical cases. It was then discovered that hysterectomy was yielding less than 50 per cent of 5 year cures in this disease, which was a great surprise to the majority of surgeons who had assumed that the percentage of cures was much higher. It was realized, of course, that the advanced age of many of the patients increased the risk of the operation and that other conditions such as diabetes, arterial hypertension, arteriosclerosis, obesity, nephritis, and cardiac disease were not uncommon complications in these elderly patients. Such conditions when present add considerably to the danger of operation. Nevertheless, hysterectomy has continued to be the method of choice for all cases in the hands of most surgeons, despite the heavy risk and the poor total salvage obtained.

However, we can be encouraged for it looks as if we may meet the problem by combining radiation therapy with surgery. Histologically cancer of the body of the uterus is known as adenocarcinoma, a form of gland cancer. It can be divided readily into two large groups based upon variations in histological characteristics. One group known as adenoma malignum includes the tumors which are well differentiated histologically, tend to remain localized to the endometrium for a long time before throwing out metastases, and offer an excellent prognosis with hysterectomy. About 50 per cent of all cases of cancer of the body fall into this group and these are the cases that usually are cured by hysterectomy alone. The remaining 50 per cent are not so well differentiated histologically, the cancer cells grow more diffusely and infiltrate the stroma, and there is much greater variation in cellular characteristics. These cases are much more malignant than those in the first group and throw out lymphatic metastases much sooner. We restrict the term adenocarcinoma to this more highly malignant tumor group.

The end-results of treatment in this group by hysterectomy alone are very poor—not over 15 to 20 per cent will survive 5 years—whereas when adequate treatment with radium and roentgen-ray precedes hysterectomy the percentage of cures may reach 60 to 85 per cent. In other words, it is important for us to know that about 50 per cent of all cases of cancer of the body of the uterus have a cell structure that is highly malignant but is quite radiosensitive. If we persist in treating this variety of cancer of the uterus by hysterectomy alone we will fail to cure it, but if we resort to radiation before operation the results will be much happier.

We have in our records at the Memorial Hospital 47 cases of cancer of the body of the uterus that were treated 5 or more years ago, and 40 of these patients have lived 5 to 15 years after treatment. This is a 5 year cure rate of 85 per cent. Every one of the 47 cases received radiation with roentgen-ray or radium, or both, as an essential and important part of their treatment. In 29 of the cases, abdominal panhysterectomy was combined with the radiation. Seven patients subsequently died, the 22 remaining have lived from 5 to 12 years. Eighteen patients were treated by radiation alone; all are alive 5 to 15 years since treatment.

From a study of our records it would seem that a cure reasonably may be anticipated by hysterectomy alone in the more differentiated tumor types, and that the chance of obtaining a cure in the less differentiated tumor types is greatly increased if efficient radiation therapy precedes the hysterectomy.

It is extremely important to know that in all cases of cancer of the uterine body in which there are serious contra-indications to hysterectomy, radiation therapy alone may be relied upon to give splendid results.

I would again like to emphasize that 40 of 47 cases of cancer of the body of the uterus, treated by a carefully chosen plan of radiation and surgery to fit the individual case, have been cured for periods of 5 to 15 years, a total salvage of 85 per cent in this group.

CARCINOMA OF THE FEMALE PELVIC ORGANS

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THE histories have been reviewed, and questionnaires recently have been sent to 3,444 women who received treatment for carcinoma of the pelvic organs between the years 1910 and 1927. Of these 1,176 lived 5 years or more after treatment. Patients not traced are assumed to have died from carcinoma.

Carcinoma always starts in a single cell; hence all papers on this subject stress the point that a relatively high percentage of cures can be expected when treatment is started early. It is unfortunate, however, that even today the majority of patients who come to hospitals, where recognized, adequate treatment can be given, are well past the hopeful stage. In most cases palliation and relief of pain are all that can be looked for with present knowledge.

The degree and type of malignancy, as shown by microscopic examination of the tissue, the age of the patient, the length of time the symptoms have been present, the extent of the local disease, and the situation of the lesion are useful in prognosis, but of most importance is to give adequate treatment at an early stage of the disease. Surgical removal of the lesion, when indicated, must be radical and when the malignancy is graded 3 or 4, according to Broders' classification, the prospect of cure is poor except in early cases. If surgical removal is undertaken it always should be followed by treatment with roentgen rays or radium, or both.

Best results will be obtained when the treatment of carcinoma in any part of the body is directed by surgeons, pathologists, radiologists, and roentgenologists specializing in that particular field and working in close co-operation. Of great importance also is a careful follow-up system, and periodic examinations with early treatment of any recurrence of the lesion. Follow-up and early treatment of recurrence of course is difficult except in large cities, where the majority of the patients come from relatively short distances.

In this series 1,204 of the 3,444 patients were treated by operation alone, and 557 lived 5 years or more; 642 were treated by operation followed by irradiation, and 293 lived 5 years or more; 1,598 patients were treated by irradiation alone, and 326 lived 5 years or more.

The results obtained by various types of treatment in the total series of cases encountered at the Mayo Clinic from 1910 to 1927, inclusive, may be noted in Table I. The results of treatment according to the situation of the malignant growth are to be found in Table II.

Many physicians at the present time are only too ready to treat all patients with carcinoma by non-surgical methods. I believe that more lives will be saved by careful selection of cases and by a combination of surgery and irradiation when indicated. Statistics in this country reveal a mortality of from 2 to 10 per cent for radical operation on pelvic organs in cases of malignancy. Unless the operative mortality can be maintained at less than 4 per cent, physicians are not justified in urging surgical removal, as good results can be obtained in a fair percentage of cases by properly applied treatment by means of roentgen-rays and radium. The risk is practically negligible, and patients have received marked help and palliation.

In recent years, knowledge of the factors that influence the curability of carcinoma has progressed, and by proper selection of the type of treatment in the individual case better results are being obtained. I am certain that a greater percentage of patients with carcinoma are being cured for 5 years or more than statistics now available show. When the only hope for the patient with carcinoma was removal of the lesion by operation the results as a whole were disappointing. However, the following reports of cases, in which the patients have lived for many years following surgical removal alone of extensive lesions, and in some cases lesions of high grade malignancy, illustrate what can be accomplished.

REPORT OF CASES

CASE 1. A woman, age 58 years, was operated on at The Mayo Clinic January 29, 1908. Panhysterectomy was performed, and both oviducts and ovaries were removed. The pathologists reported that the lesion was a carcinoma of the body of the uterus. Examination of the preserved specimen made recently, so that Broders' method of grading could be applied, disclosed that it was an adenocarcinoma, graded 1. The patient had gall stones at the time of operation, but the biliary tract was not disturbed. She returned to the clinic in 1915, and cholecystectomy was performed April 5, 1915. April 12, 1933, the patient reported that she considered that she was in good health for a woman of her age, although a little digestive disturbance still persisted. More than 25 years have elapsed since the operation for adenocarcinoma of the uterus.

CASE 2. A woman, age 50 years, was operated upon on November 25, 1907, at which time abdominal hysterectomy was performed. A small portion of the cervix was left. Both ovaries and oviducts were removed. A diagnosis of carcinoma of the body of the uterus was made. Recent

TABLE I.—MALIGNANT CONDITIONS OF THE PELVIS: 1910 TO 1927, INCLUSIVE (3,444 CASES)[1]

Type of operation	Operation only			Operation with irradiation		
	Total	Lived five years or more		Total	Lived five years or more	
		Cases	Per cent		Cases	Per cent
Total hysterectomy	449	234	52.11	293	149	50.85
Vaginal hysterectomy	114	53	46.49	54	28	51.85
Subtotal hysterectomy	230	125	54.34	98	50	51.02
Amputation of cervix	4			12	4	33.33
Cautery to cervix	82	5	6.09	32	9	28.12
Percy cautery	77	5	6.49	14	1	7.14
Local excision	242	130	53.71	133	47	35.33
Excision with dissection of lymph nodes	6	5	83.33	6	5	83.33
Total	1,204	557	46.26	642	293	45.64

[1]In 1,598 cases irradiation only was given; 326 (20.40 per cent) of the patients lived 5 years or longer.

TABLE II.—MALIGNANT CONDITIONS OF THE PELVIS: 1910 TO 1927, INCLUSIVE (3,444 CASES)

Situation of growth	Operation only			Operation with irradiation			Irradiation only		
	Total	Lived five years or more		Total	Lived five years or more		Total	Lived five years or more	
		Cases	Per cent		Cases	Per cent		Cases	Per cent
Cervix	359	86	23.95	222	87	39.18	1,242	260	20.93
Body of uterus	331	193	58.30	150	87	58.00	161	32	19.87
Ovary	449	255	56.79	226	102	45.13	78	11	14.10
Vagina	11	2	18.18	6	1	16.66	63	15	23.81
Vulva	34	17	50.00	22	11	50.00	37	3	8.11
Fallopian tubes	5	1	20.00	1					
Perineum	3	2	66.66	1	1	100.00	1		
Urethra				1			16	5	31.25
Multiple growths	12	1	8.33	13	4	30.76			
Total	1,204	557	46.26	642	293	45.63	1,598	326	20.40

study of the specimen revealed that it was an adenocarcinoma, graded 2. In March, 1928, the patient reported that she was in fair health, and that she did not have any pelvic pain or other difficulty. She was then 71 years of age, and had lived 20½ years since the operation for extensive adenocarcinoma of the uterus, graded 2.

CASE 3. A woman, age 65 years, was operated upon on May 14, 1908, at which time vaginal hysterectomy with clamp and cautery was performed. The pathologists reported the presence of an epithelioma of the cervix. The specimen was recently examined for the purpose of grading, and was found to be a squamous cell epithelioma, graded 2. The patient returned in July, 1915, because of a lump in her right breast. July 29, 1915, radical amputation of the breast was performed. The lesion was a carcinoma in a region of cystic mastitis; involvement of lymph nodes was not demonstrable. This lesion was recently studied for the purpose of grading, and proved to be an adenocarcinoma, graded 2. The patient died in April, 1931, 23 years after hysterectomy and 16 years after amputation of the breast. According to the report from her daughter, the cause of death was "cancer near the liver."

CASE 4. A woman, age 41 years, was operated upon on October 22, 1912, at which time total abdominal hysterectomy and bilateral salpingo-oophorectomy were performed for carcinoma of the cervix. The specimen was recently examined again for the purpose of grading, and was reported to be an adenocarcinoma of the cervix, graded 1. The patient came to the clinic again in March, 1920, and a hard mass was found in the posterior vaginal wall which had every appearance of recurring carcinoma. Treatment with radium was given. In November, 1929, she returned for consultation regarding increase in the frequency of attacks of pain in the upper part of the abdomen which had been occurring at intervals since 1910. She stated that otherwise she was in excellent health. Examination revealed that gall stones were present. The patient's general condition was very good. The vaginal wall was smooth and free from infiltration, and there was no sign of activity of the malignancy. The patient wrote in October, 1932, that she is now 72 years of age, and apparently in good health.

CASE 5. A woman, age 46 years, was operated upon on February 6, 1912, at which time subtotal abdominal hysterectomy with removal of both ovaries and oviducts was performed because of a malignant cystadenoma in the right ovary. Recent examination of the tissue for the purpose of grading revealed that it was an adenocarcinoma, graded 4. In May, 1923, appendectomy was performed because of chronic appendicitis. Exploration of the gall bladder, liver, and pelvis at that time gave negative results. There was no sign of any malignant process. This patient has been examined at regular intervals since 1912, and has been found to be in good general health. She has lived 21 years following removal of an adenocarcinoma, graded 4, of the right ovary.

CASE 6. A woman, age 37 years, was operated on, July 16, 1917, at which time practically total abdominal hysterectomy, with removal of both ovaries and oviducts was carried out because of a bilateral carcinomatous cystadenoma of the ovaries. At this operation gall stones were found, but it was decided to attend to these later. July 28, 1917, cholecystectomy for cholecystitis with cholelithiasis was performed. In a letter written in July, 1933, the patient stated that her general health has been good since the operation in 1917.

SUMMARY

This study reveals that many patients with carcinoma can be cured. Some of the patients in this series are alive and well more than 25 years following operation alone. Radical operations for

malignant lesions of the pelvic region should not be attended by a mortality rate of more than 4 per cent. Since the introduction of treatment by radium and deep roentgen-rays, and since both physicians and laymen realize the necessity of early treatment by specialists, there is no doubt that cure is being effected in a larger percentage of cases than ever before.

CANCER OF THE UTERUS IS CURABLE

CARL HENRY DAVIS, M.D., F.A.C.S., MILWAUKEE, WISCONSIN

THERE is good reason for the belief that preventive treatment of ectropion and erosion of the cervix will, by destroying abnormal cells, reduce materially the incidence of cancer in this area. Thus far there are no preventive measures for cancer of the corpus uteri. However, cancer of the uterus regardless of its location, if diagnosed and treated in its first stage, can be cured by both surgery and radiation therapy.

My part in this symposium is to report the cures from a small group of cancer patients diagnosed and treated in private practice during an 8 year period ending September 30, 1928. Only 9 women examined during this period had cancer of the cervix; 2 with early lesions, 2 with stage III lesions, and 5 with stage IV lesions. One patient treated by high amputation of the cervix and radium has remained apparently free from cancer for 10 years. One patient with an early lesion was treated by cauterization following the biopsy, and by radical removal of the uterus soon after the microscopic diagnosis was made. It is 7½ years since the operation and she is perfectly well. One patient with a stage III lesion was treated with surgical diathermy and radium. She developed a vesicovaginal fistula, but is apparently free from cancer 8 years and 9 months after treatment. Cancer of the corpus uteri was diagnosed four times. Two patients were treated by surgery alone, 1 by radium and surgery, and 1 by radium only. One patient treated surgically died from a heart condition 2 years later without any further evidence of cancer. The patient who had intra-uterine radium followed 1 week later by surgery, died of peritonitis. It is now recognized that one must avoid surgery for at least 4 weeks after the use of radium. One patient treated by surgery alone is alive and well 12½ years after her operation, notwithstanding the fact that the entire cavity of her uterus was involved. The patient treated by intra-uterine radium alone was in a very poor physical condition when first seen, being fat and having a decompensated heart, nephritis, and a high blood pressure. She was kept in bed under medical treatment for 4 weeks before we considered it safe to administer gas for the diagnostic curettage and the first introduction of radium. She has lived for 13 years since her treatment and appears to be free from cancer.

To summarize: Three of 9 patients with cancer of the cervix diagnosed in my private practice during an 8 year period ending September 30, 1928, are alive and apparently free from cancer, 10 years, 8 years and 9 months, and 7½ years following treatment. Two of 4 patients with cancer of the corpus uteri are alive and apparently free from cancer 13 and 12½ years after treatment. One patient died from a heart condition 2 years after treatment, being apparently free from cancer at the time.

Everyone should recognize that the cancer problem is by no means discouraging if compared with other common chronic conditions such as heart disease, nephritis, and insanity. The percentage of cancer cures is relatively small only because early treatment of this condition is usually the result of an accidental diagnosis made while examining a patient who has no suggestive symptoms of cancer. We must recognize that the symptoms commonly associated in the minds of physicians with cancer of the uterus are those of an advanced lesion. The most important factor in the cancer problem, therefore, is early diagnosis before the time of ulceration and metastasis. However, to accomplish this requires that the average physician must know more about examination of the pelvic organs, and every woman must have a periodic physical examination including a careful inspection of the areas commonly susceptible to cancer. The economic stringency has greatly reduced the number of women who have regular examinations and the only cancers I have seen during the past 3 years have been far advanced, when cure is rarely possible and palliation difficult. By some means we must educate all women to appreciate the importance of an annual physical examination during the earlier years, and a semi-annual examination when they reach the cancer age. Naturally our charges must be adapted to changing economic conditions.

CAN WE INCREASE THE PERCENTAGE OF CURES IN CANCER OF THE CERVIX UTERI

GEORGE GELLHORN, M.D., F.A.C.S., St. Louis

TO the 1,561 cases of cervical cancer reported as cured in last year's symposium I wish to add 64 cases, or 11.3 per cent of a total of 566 cases treated at the Barnard Free Skin and Cancer Hospital, St. Louis, from 1906 to October 1, 1928. From 1906 to 1916 the treatment was in the main merely palliative; less advanced cases were few in number, and in these surgical treatment was employed. Yet, of the 147 patients of this series, 9 are alive and well from 16 to 25 years, respectively, after operation. In 1917 radium was added to our modes of treatment. Of the 419 patients of this period, 410 were subjected to treatment, and of these, 55 are alive and well, the cures ranging between 5 and 15 years. In this series there are 40 operations with 21, or 52.5 per cent, cures, and 317 radium treatments with 34, or 8.91 per cent, cures. Not included in these statistics are the cases in which after 5 or more years of well-being there was finally a recurrence of the cancer.

The successes reported last year and today prove conclusively that *cancer of the cervix uteri can be cured*. This fact cannot be impressed too strongly or too often upon the minds of both the medical profession and the lay public. When Dr. Martin conceived the idea of annual symposia on cancer cures, one of his principal objects was to bring about earlier recognition and treatment. This object, no doubt, eventually will be accomplished, but it will take much time because humanity in the aggregate moves exasperatingly slowly, even when its own best interests are at stake. Remember there is even today an anti-vaccination movement!

Meanwhile, however, we ourselves can do a good deal to improve existing conditions; for while we justly may be elated over every patient whom we have saved from certain death, we must admit to ourselves that the net results are still pitifully meager.

In late years the surgical side of the treatment of cervical cancer has been largely discarded. This, to my mind, is unwarranted by fact and contrary to the principle of individualization in medicine. I never can make myself believe that every single case should be treated alike and treated exclusively with radium. It is true that the radical abdominal operation is too difficult for the average operator, but these technical difficulties can be overcome by practice on the cadaver. This applies even more strongly to the radical vaginal operation which has the advantage of a lesser primary mortality. I presented the steps of this operation before the Third Clinical Congress, held in New York in 1912, and I have found the method advantageous in a constantly increasing number of cases. Last year corroborative evidence was given by MacLean, of Winnipeg, who cured all of his 5 cases of cervical cancer by this operation.

Radiotherapy, too, is capable of improvement. Statistics claiming 20 or more per cent of cure after treatment with small quantities of radium are probably unreliable. Taylor, working with 140 milligrams, had only 17.4 per cent cures. Our own results with 150 milligrams were even smaller (13.7 per cent). Ward, operating with the enormous amount of 280 milligrams, achieved cure in 24.8 per cent. Burnam's report was highly instructive. Though he had the advantage of most of us in years of experience and supply of radium available, his percentage of cures was only 15.96 when the entire period of 16 years was estimated. In the last 3 years of his investigation, however, the results steadily improved and in 1927 mounted to 29.68 per cent. This can mean only one thing, namely, that with the increase of personal knowledge and improved methods of application the results of radium therapy can be bettered. Considerations of this sort led me to devise a new method of application which I have called the combined abdominovaginal attack, a description of which will be published in the near future.

In the prevention of cervical cancer significant advances likewise can be made. At present this prevention is confined largely to the removal of cervices which at some later and indefinite time *may* exhibit the growth of a cancer. While this reasoning is theoretically sound, its accurate scientific proof is still lacking, and the indiscriminate ablation of all, however slightly lacerated, cervices, may lead to much unnecessary surgery. On the other hand, there is in our field one form of *actual* prevention, namely, that of cancer in the cervical stump following supravaginal hysterectomy. Ward had 19 such instances in his records of 357 cases. In our hospital we have seen no less than 39 cases of this sort, to which may be added four from my private clientele. No matter

how large or how small the percentage of cancer in the stump of cervix may be in the total number of cervical cancers, these 19 or these 43 patients, or the 500 odd that may be found in the American literature, would actually not have developed cancer had their cervices been removed at the time of the first operation. Here at least we are on the basis of hard, unalterable facts; and compared with them all arguments in the frequent controversies on complete *versus* incomplete hysterectomy appear fatuous and ill advised.

I take it that these symposia are not meant to be mere repetitions of figures and percentages of cures accomplished. That, at the end of another year or two, would be tiresome. But, if they lead to constructive introspection, the object would be achieved even beyond the expectations of their originator.

FIVE YEAR END-RESULTS OF THE TREATMENT OF CARCINOMA OF THE CERVIX, FUNDUS, AND OVARY

CHARLES C. NORRIS, M.D., F.A.C.S., PHILADELPHIA

THE following is a report upon all cases of carcinoma of the cervix, body of the uterus, and ovary in which application for treatment was made at the John G. Clark Clinic of the Hospital of the University of Pennsylvania during the years 1924, 1925, and 1926. These statistics include all cases whether the patients were treated or untreated. Those which it was impossible to trace are listed as dead. In all cases the diagnosis has been verified by histological examination, except in a few of the Stage IV cervical carcinoma, none of which survived 5 years.

The term "absolute cure" is here employed to designate the proportion of patients living at the end of 5 years in relation to the total number of patients seen. "Relative cure" refers to the proportion living at the end of 5 years in relation to the number treated.

TABLE I.—CARCINOMA OF CERVIX, BODY OF UTERUS, AND OVARY 1924–1925–1926

	Patients seen	Living 5 years	Per cent absolute cure	Per cent relative cure
Cervix	153	35	22.8	25.1
Body of uterus	49	28	57.1	58.3
Ovary	44	22	50	50
	246	85		

	Number	Per cent
Patients seen	246	100.0
Patients treated	231	93.9
Five year follow-up (all patients)	219	89.02
Absolute cures in 246 patients seen	85	34.5
Relative cures in 231 patients treated	85	36.7
Primary mortality in 231 patients treated	2	0.86

TABLE II.—CARCINOMA OF CERVIX

— Classification — Schmitz	League of Nations	Patients seen	Living 5 years	Per cent absolute cure	Per cent relative cure
Stage I	Stage I	29	13	44.8	44.8
Stage II	Stage I	19	5	26.3	26.3
Stage III	Stage II and III	58	12	20.6	21.0
Stage IV	Stage IV	47	5	10.6	14.7
		153	35		

	Number	Per cent
Patients seen	153	100.0
Patients treated	139	90.8
Five year follow-up (all patients)	136	88.8
Absolute cures in 153 patients seen	35	22.8
Relative cures in 139 patients treated	35	25.1
Primary mortality in 139 patients treated	1	0.7

Attempts to formulate a prognosis on the basis of the predominant cell type were only partially successful as shown by the report on cervical cancer given at the symposium last year. The transitional cell type resulted in 26.66 per cent salvage, whereas the spindle cell type showed only 13.05 per cent surviving the 5 year period.

Most of our early patients with carcinoma of the cervix were treated with radium (2,400 milligram hours—filter of 1 millimeter of silver or 2 millimeters of brass and 2 millimeters of soft rubber tubing) and with a second irradiation 6 weeks later. In 5 cases the radium irradiation was supplemented with deep X-ray therapy.

We have been dissatisfied with our results and have modernized our method of irradiation. From a study of our present methods, it appears certain that our next report will show a definite improvement.

TABLE III.—CARCINOMA OF CERVICAL STUMP (PREVIOUS SUPRAVAGINAL HYSTERECTOMY[1])

	Patients seen	Living 5 years	Per cent absolute cure	Per cent relative cure
Stage I Schmitz	3	2	33.3	33.3
Stage II Schmitz	1			
Stage III Schmitz	0			
Stage IV Schmitz	2			
	6			

	Number	Per cent
Patients seen	6	100.0
Patients treated	6	100.0
Five year follow-up	6	100.0
Absolute cures	2	33.3
Relative cures	2	33.3
Primary mortality	0	0

[1]These cases also included in Table II.

TABLE IV.—CARCINOMA OF THE BODY OF THE UTERUS

Patients seen	Living 5 years	Per cent absolute cure	Per cent relative cure
49	28	57.1	58.3

	Number	Per cent
Patients seen	49	100.0
Patients treated	48	97.9
Five year follow-up (all patients)	49	100.0
Absolute cures in 49 patients seen	28	57.1
Relative cures in 48 patients treated	28	58.3
Primary mortality in 48 patients treated	1	2.0

TABLE V.—CARCINOMA OF THE BODY OF THE UTERUS; RESULTS SECURED BY VARIOUS METHODS OF TREATMENT

	Patients	Living 5 years	Per cent absolute cure	Per cent relative cure
Irradiation (radium)	28	15	53.5	53.5
Operation	5	3	60.0	60.0
Operation and radium irradiation	15	10	66.6	66.6

Preliminary irradiation for carcinoma of the body of the uterus usually consisted of 2,400 milligram hours of radium which accompanied a diagnostic curettage. Cases in which a diagnostic curettage is required are usually the relatively early cases and this is probably a factor in the better results secured in this group. Irradiation alone was employed only in those cases in which a radical operation was contra-indicated on account of advanced age or some other associated condition.

TABLE VI.—CARCINOMA OF THE OVARY

Patients seen	Living 5 years	Per cent absolute cure	Per cent relative cure
44	22	50	50

	Number	Per cent
Patients seen	44	100.0
Patients treated	44	100.0
Five year follow-up (all patients)	42	95.4
Absolute cures in 44 patients seen	22	50
Absolute cures in 44 patients treated	22	50
Primary mortality in 44 patients treated	0	0

TABLE VII.—CARCINOMA OF THE OVARY
HISTOLOGICAL VARIETY

	Patients	Living 5 years	Per cent absolute cure	Per cent relative cure
Papillary	17	11	64.7	64.7
Glandular	15	9	60	60
Unclassified	12	2	16.6	16.6
	44	22	50	50

The cases of carcinoma of the ovary were treated routinely by panhysterectomy and bilateral salpingo-oophorectomy. However, for various reasons, less radical operations were performed upon some of these patients, and it is among the latter that the greatest 5 year mortality exists. At present postoperative roentgen therapy is employed for all cases, but it was not routinely used in this series.

It will be noted that there were better results secured in cases of papillary, than in glandular, ovarian carcinoma.

CARCINOMA OF THE GENITO-URINARY TRACT

Five Year Cures

HERMAN L. KRETSCHMER, M.D., F.A.C.S., Chicago

THE problem of the urologist is similar to that of other surgeons, namely, to have the opportunity of making early diagnosis and instituting early treatment. Hæmaturia, one of the most constant symptoms, often the only and frequently the earliest symptom, is given but slight, if any, importance by the laity, and, unfortunately, by a large number of physicians. Our campaign against the disease should stress not only early recognition of cancer, but the fact that cancer is curable, as is now being done by the American College of Surgeons.

Carcinoma of the kidney. I wish to present at this time a tabulation of 7 cases of malignant disease of the kidney that have remained well for 5 years or more (Table I).

Carcinoma of ureter. I have no cases of carcinoma of the ureter to report in which the patient lived 5 years or more after operation.

Carcinoma of bladder. I wish to place on record 22 cases of carcinoma of the bladder in which the patients remained well for 5 years or more (Table II). In this series of cases there were 17 males and 5 females. The youngest patient was 44 years of age and the oldest was 72; the average age in this group being 60.8 years. In each case the diagnosis was made by microscope. Various methods of treatment were used: the largest number were treated by means of suprapubic cystotomy and surgical diathermy; some were treated with diathermy and radium; some with radium alone; 2 by means of resection; and 1 with fulguration through the cystoscope.

The fulguration case proved to be an unusually interesting one. Three months before I saw the patient he had had a suprapubic cystotomy and surgical removal of a tumor which proved on microscopic examination to be a papillary carcinoma. When I saw him three months after the operation there was a recurrence the size of a pecan. This second tumor was removed with a cystoscopic rongeur and the base was given two cystoscopic fulgurations. Histological examination of the recurrent tumor proved it to be a papillary carcinoma. The patient is still living and free of symptoms 19 years later. He has however, refused to submit to a cystoscopic examination.

Carcinoma of prostate. I have not included cases of carcinoma of the prostate since the diagnosis was made upon rectal examination and not verified by microscopic examination.

TABLE I.—KIDNEY

No.	Case	Age	Sex	Microscopic diagnosis	Operation	Result
1	J. K.	47	M	Hypernephroma	Nephrectomy	Living and well after 12 yrs.
2	E. S.	52	M	Hypernephroma	Nephrectomy	Living and well after 12 yrs.
3	A. M.	65	F	Hypernephroma	Nephrectomy	Lived for 12 years; died of carcinoma of liver
4	H. A.	46	M	Hypernephroma	Nephrectomy	Living and well after 10 yrs.
5	C. C.	50	M	Carcinoma of renal pelvis	Nephrectomy	Lived for 7 years; died of pneumonia
6	L. J. W.	1½	F	Adenomyosarcoma; Wilms tumor	Nephrectomy	Living and well after 5 yrs.
7	W. B.	71	M	Hypernephroma	Nephrectomy	Living and well after 5 yrs.

TABLE II.

No. Sex	Age	Microscopic diagnosis	Type of treatment	Duration of cure	Result
1 M	64	Papillary carcinoma	Suprapubic cystotomy elsewhere; fulguration	19 years	Living
2 M	60	Papillary carcinoma	Fulguration	16 years	Living
3 M	72	Papillary carcinoma	Surgical diathermy and radium	11 years	Living
4 M	69	Papillary carcinoma	Resection of bladder	10 years	Living
5 M	56	Papillary carcinoma	Surgical diathermy	9 years	Living
6 M	56	Papillary carcinoma	Surgical diathermy	9 years	Living
7 F	64	Carcinoma	Operation elsewhere; fulgurations	9 years	Living (recurrence)
8 M	54	Papillary carcinoma	Surgical diathermy	8 years	Living
9 M	44	Carcinoma	Surgical diathermy	8 years	Living
10 M	64	Papillary adenocarcinoma	Surgical diathermy	8 years	Living
11 F	48	Papillary carcinoma	Surgical diathermy	7 years	Living
12 F	70	Papillary carcinoma	Surgical diathermy	7 years	Living
13 M	58	Papillary carcinoma	Surgical diathermy	7 years	Living
14 M	57	Papillary carcinoma	Surgical diathermy; radium 2 yrs. later	7 years	Living
15 M	69	Papillary carcinoma	Surgical diathermy	7 years	Died (recurrence)
16 M	60	Papillary carcinoma	Resection	7 years	Died of hyperthyroidism and auricular fibrillation
17 M	63	Papillary carcinoma	Surgical diathermy	6 years	Living
18 F	62	Papillary carcinoma	Surgical diathermy	6 years	Living
19 F	60	Papillary carcinoma	Surgical diathermy	6 years	Living
20 M	65	Squamous cell carcinoma	Surgical diathermy	5 years	Living (recurrence)
21 M	67	Papillary carcinoma	Surgical diathermy	5 years	Died of pneumonia
22 M	57	Papillary carcinoma	Surgical diathermy	5 years	Living (recurrence)

SUMMARY OF THE END-RESULTS OF TREATMENT OF MALIGNANCY OF THE THYROID GLAND AND THE COLON, INCLUDING THE RECTUM AND ANUS

JOHN DEJ. PEMBERTON, M.D., F.A.C.S., AND CLAUDE F. DIXON, M.D., F.A.C.S., ROCHESTER, MINNESOTA

CONTRARY to the belief prevalent in the mind of the public and, to some extent, in the minds of members of the medical profession, that cancer of the thyroid gland is an utterly hopeless disease, experience suggests and factual data show that, following combined surgical treatment and irradiation, the prognosis of cancer of the thyroid gland is as favorable as that of any organ, excluding that of the skin and of the lip.

From January 1, 1907, to July 1, 1928, operations have been performed in The Mayo Clinic on 323 patients with cancer of the thyroid gland, which constitute 1.03 per cent of all the patients operated on for goiter. Although the age incidence corresponds to that of carcinoma in general, 69 per cent of the patients being within the fourth, fifth, and sixth decades of life, it is worthy of emphasis that more than 3 per cent were in the first and second decades (Table I). In 56 of these cases (Table II) the operation was limited to removal of only a specimen of the growth for pathologic study and grading. All of these 56 patients subsequently received irradiation treatment. In the remaining 267 cases, (82.66 per cent) recorded in Table III, the operation for removal of the malignant growth consisted of partial or almost complete thyroidectomy, with or without removal of the cervical lymph nodes. Eleven of the 323 patients died in hospital, a mortality rate of 3.4 per cent. Of the remaining 312 patients, 137 (43.9 per cent) have lived 5 years or longer, and 64, or nearly 20 per cent, have lived more than 10 years. Of the 137 patients who have lived 5 years or longer, the treatment in 10 (7.3 per cent) consisted of irradiation alone, and in 127 (92.7 per cent) of radical removal with or without postoperative irradiation.

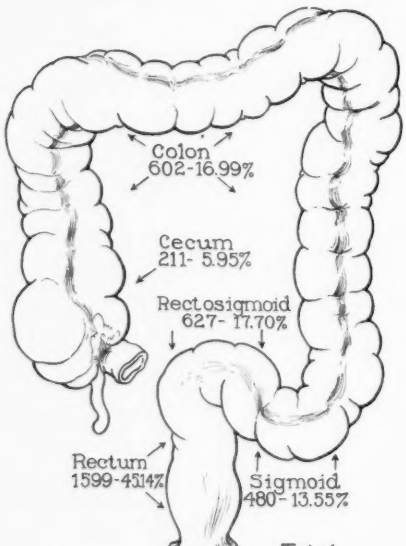

Fig. 1. Situation and relative frequency of occurrence of malignant growths of the colon and rectum.

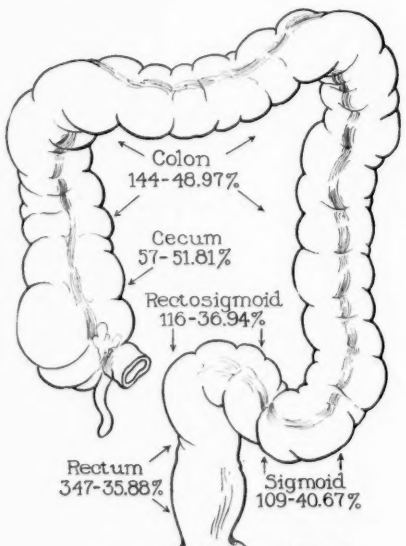

Fig. 2. The number and percentage of patients who survived resection 5 years or more.

Because of the high percentage of the relatively low grades of malignancy (71 per cent were graded 1 or 2) and because of the peculiar radiosensitiveness of carcinoma of the thyroid gland, in many cases of inoperable cancer, and in many of those in which there is local recurrence, the growth can be reduced in size or held in abeyance for many years without serious impairment of general health. Thus of the 137 patients who have lived 5 years or longer, local recurrence or persistence of the malignancy was present in 42, and its presence or absence was unknown in 23. However, it is known that 72, or 24.35 per cent of all the patients treated, lived without evidence of recurrence of cancer for 5 years or longer. All of the 72 patients who lived 5 years or more and are known to be free of recurrence were subjected to thyroidectomy, and represent 27.76 per cent of all the patients so treated.

TABLE I.—MALIGNANT CONDITIONS OF THE THYROID: AGE INCIDENCE

Years	Cases	Per cent
1 to 9	2	0.62
10 to 19	8	2.47
20 to 29	31	9.00
30 to 39	60	18.57
40 to 49	89	27.55
50 to 59	73	22.00
60 to 69	53	16.41
70 to 79	7	2.16
Total	323	

Since a very high percentage of malignancy occurs among patients with pre-existing nodular goiter, adenomatous goiter must be thought of as

TABLE II.—MALIGNANCY OF THE THYROID

End-Results in 56 Cases in Which Biopsy Was Secured and Irradiation Was Applied (January 1, 1907, to July 1, 1928)

	Grade 1		Grade 2		Grade 3		Grade 4		Total	
	Cases	Per cent*	Cases	Per cent*	Cases	Per cent*	Cases	Per cent*	Cases	Per cent*
Lived less than 5 years	9	64.28	10	62.50	5	71.43	16	100.00	40	75.47
Lived 5 to 9 years	3	21.42	4	25.00	1	14.29			8	15.09
Lived 10 years or more			2	12.50					2	3.77
Dead, time not known										
Not traced	2				1				3	
Hospital mortality			2		1				3	5.36
Total	14		18		8				56	
Patients living 5 years or more	3	21.42	6	37.50	1	14.28			10	18.86

*Based on total cases less hospital mortality.

TABLE III.—MALIGNANCY OF THE THYROID

End-Results in 267 Cases in Which Thyroidectomy Was Performed with or without Post-Operative Irradiation (January 1, 1907, to July 1, 1928)

	Grade 1		Grade 2		Grade 3		Grade 4		Total	
	Cases	Per cent*	Cases	Per cent*	Cases	Per cent*	Cases	Per cent*	Cases	Per cent*
Lived less than 5 years	24	28.23	33	30.55	16	45.71	24	77.42	97	37.45
Lived 5 to 9 years	21	24.70	29	26.85	10	28.57	5	16.13	65	25.09
Lived 10 years or more	28	32.94	29	26.85	5	14.28			62	23.94
Dead, time not known	2		1		1				4	
Not traced	10		16		3		2		31	
Hospital mortality			4		3		1		8	2.99
Total	85		112		38		32		267	
Patients living 5 years or more	49	57.64	58	53.70	15	42.85	5	16.13	127	49.03
Total patients living 5 years or more (10 from Table II and 127 from Table III)	52	52.52	64	51.61	16	38.09	5	10.63	137	43.91

*Based on total cases less hospital mortality.

a precursor of malignancy, and since early malignancy of the thyroid gland presents no symptoms to enable it to be distinguished from benign nodular goiter, a potential risk of malignancy should be considered in every case of nodular goiter.

At The Mayo Clinic 3,542 patients with malignancy of the colon and rectum were operated on from 1907 through June, 1928. Of this number, 834 survived for 5 years or longer. We have been able to obtain follow-up information on all patients except 171, or 5.77 per cent.

The types of malignancy are shown in Table IV. Situation and relative frequency of occurrence are shown in Figure 1. Figure 2 serves to show not only the number and percentage of patients who have lived 5 years or longer following resection but also the percentage of survival with regard to the segment of bowel involved. In addition to this group, which numbers 776, 58 patients with malignancy of the colon and rectum have lived 5 years or longer. In these cases the lesion was treated by methods other than resection, such as local excision and application of radium.

It is of considerable interest that we have been able to trace all but 5.77 per cent of these patients postoperatively. It is noteworthy that this study shows that the prognosis following operation is best if the malignant growth is situated in the proximal or right portion of the colon, and that it gradually becomes less favorable as the site of the growth becomes more distant from the right side of the colon.

TABLE IV.—MALIGNANCY OF THE COLON AND RECTUM

Patients Subjected to Operation (January 1, 1907, to July 1, 1928)

Type	Total	Total lived 5 years	Per cent
Adenocarcinoma	3206	743	27.7
Colloid carcinoma	278	75	32.3
Sarcoma	17	5	38.4
Epithelioma	30	6	21.4
Melano-epithelioma	2		
Malignant adenomata	9	5	55.5
Total	3542	834	28.1

Of the 3,542 cases studied in this series, it will be found that 2,259 of the lesions occurred in the anus, rectum, and rectosigmoid. In other words, in roughly two-thirds of the cases, the growths were in position to be palpated by the index finger if a careful rectal examination were made. About 25 per cent of the patients suffering from such malignancies are operated on for hæmorrhoids before the lesion producing the symptoms is identified. If malignancy of the colon and rectum is to be detected in its early stages, digital examination of the rectum should be routine, and proctoscopic and roentgenologic studies of the colon should be included in the examination of all patients with intestinal complaints of indeterminate nature.

CANCER OF THE RECTUM

A Study of Five-Year Cures

ROBERT C. COFFEY, M.D., F.A.C.S., Portland, Oregon

THE curability of cancer depends largely on the removability of the organ involved and the accessibility of the lymphatic glands which filter out the migratory cells that have left the parent growth. These factors make the curability of cancer of the rectum very high. The operation for removing cancer of the rectum is formidable and requires both courage and skill. A case which is classed as operable by one may be classed as inoperable by another surgeon. The surgeon who is satisfied with a 25 per cent operability may do a posterior resection, or even a local resection, with low mortality and high curability, but by so doing he abandons another 25 per cent of patients whose conditions are operable in the hands of a surgeon who is bolder and does a more radical operation. The second surgeon, who has a 50 per cent operability, may have a higher mortality and a lower rate of curability for the patients operated upon and yet have a much larger number of 5-year cures in a given number of cancer patients.

The patient wants to know what chance he has of obtaining a 5-year cure, or better still, a permanent cure. This answer can be given only by reliable statistics. Statistics are valuable only when each individual reports every case that has come under his observation.

On September 8, 1913, I did my first radical abdominoperineal operation in two stages. In the first 4 cases of this type I ligated both the internal iliacs and superior hæmorrhoidal artery, and removed all the fat in the hollow of the sacrum. These patients all lived, but sloughing following such extensive devascularization was excessive. In later cases, therefore, only the superior hæmorrhoidal was ligated. Still there was sloughing and extensive suppuration in the field around the inverted rectal stump, resulting in an abscess which finally opened into the rectum. Then a plan was adopted whereby extensive drainage made up of wicks of gauze

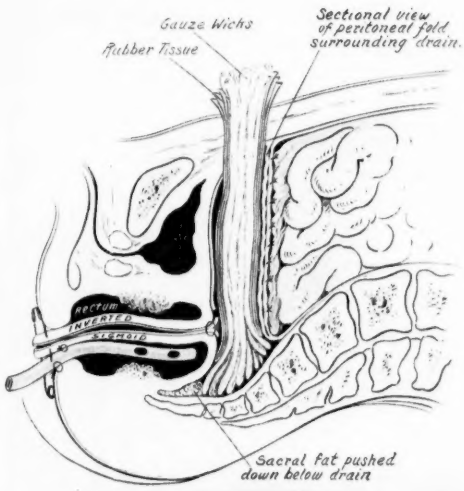

Fig. 1. First step of a two stage operation. Sectional view of drains which have been enclosed in a tube of peritoneum drawn in from the pelvic wall. Fat in hollow of sacrum is pushed down, a drainage tube in rectum and inverted sigmoid held down by a safety pin. Omentum has been sewed to the line of peritoneal sutures to add extra strength.

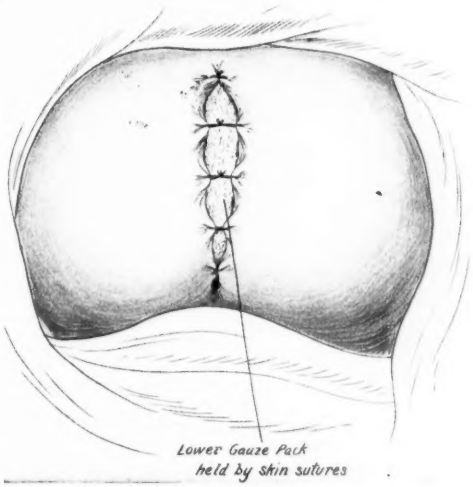

Fig. 2. The lower gauze pack is held in place by sutures which bring the skin across it. This is left 5 or 6 days before changing. The gauze wicks of the upper quarantine drain are left in place 12 days or more and the rubber tissue cover at least a week longer.

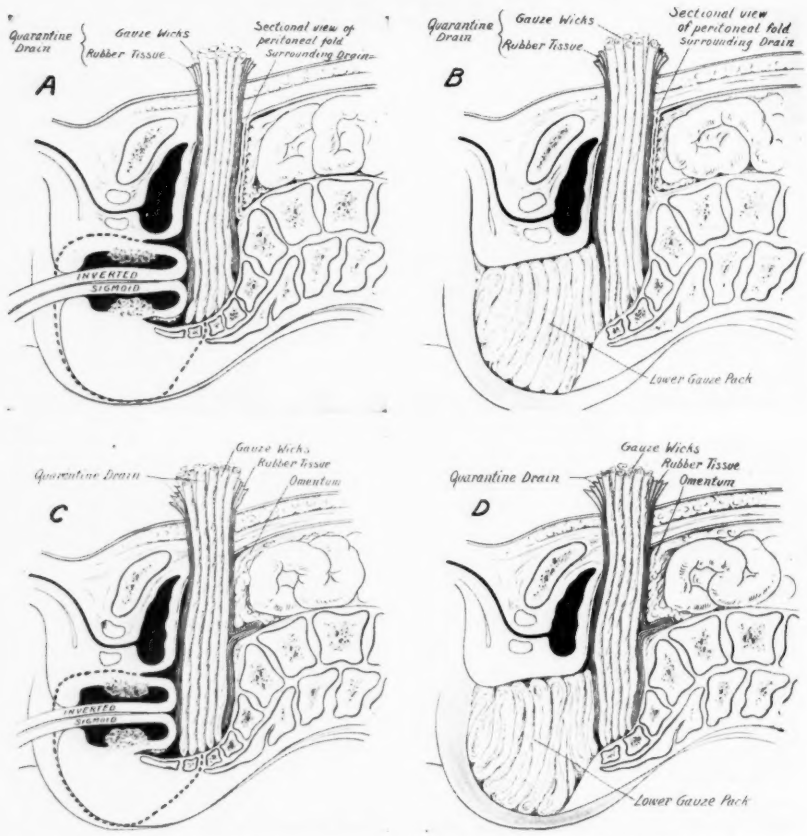

Fig. 3. One stage abdominoperineal operation. A, After removal of the pelvic fat and glands, sigmoid is inverted. A large quarantine drain of 3 dozen gauze wicks covered with 4 layers of rubber tissue fills the pelvis. When practical, a peritoneal diaphragm is drawn above the quarantine. B, The patient has been turned over in the jack-knife position, the coccyx and last joint of the sacrum removed and the rectum removed, after which the pelvic space is packed tightly with sterile gauze. C, In some cases it is impossible to make the peritoneal diaphragm. Then, the intestines are allowed to fall down against the rubber tissue cover of the quarantine, the upper sheet of which is folded upward so as to cover the sacrum and prevent intestines from contacting the raw surfaces in the pelvis. D, Upper quarantine drain and lower gauze pack in place.

protected in its passage by rubber tissue was inserted through the abdominal incision down to the neighborhood of the inverted rectum for the purpose of draining the connective tissue and localizing the infection (Fig. 1). In one week or longer, depending on the condition of the patient, the rectum was removed through a sacral and perineal wound.[1]

Table I shows the disposition of every case that has been diagnosed cancer of the rectum or rectosigmoid in our Clinic since September of 1913. Of these, 87 cases have been admitted since September of 1928, and therefore cannot be included in the study of 5-year cures. Table II includes only 5-year cures and is made up from 79 cases operated upon by the radical abdominoperineal method prior to September of 1928. Of the 79 cases, 28 either died at operation or have not been traced, leaving 51 traced cases. Of these patients who were traced, 23 died before the end of 5 years and 28 have lived for more than 5 years.

[1]Figs. 21, 22, and 23, Principles of the operation for carcinoma of the rectum, Surg., Gynec. & Obst., 1924, xxxviii, 723.

TABLE I

	Cases	Per Cent
Total cases of carcinoma of the rectum and rectosigmoid admitted September, 1913, to September, 1933	239	
Inoperable even for exploration, refused operation or went elsewhere	41	
Colostomy with or without radium	61	
Radium alone	9	
Tube resection	1	
Local resection and radium (well 4 years after operation)	1	
Explorations	13	
Radical removal		
Carcinoma of the rectosigmoid	31	
Hospital deaths	7	
Mortality rate		22.58
Carcinoma of the rectum, inversion technique	82	
Hospital deaths	6	
Mortality rate		7.31
Total radical operations	113	
Total number of hospital deaths	13	
Percentage of hospital deaths		11.5
Operability for radical removal in entire series of 239 cases		47.28

TABLE II

	Cases
Patients operated upon by the radical abdominoperineal operation more than 5 years ago	79
Patients untraced or died of operation	28
Patients traced	51
Traced patients	
Patients dying before the end of 5 years	23
Patients living 5 years or more after operation	28
Five-year cures	
1. Patients who died after expiration of 5 years	13
Lived 17 years, died at age of 82 of old age	1
Lived 13 years, died of apoplexy	1
Lived 9 years, died of myocarditis, no evidence of recurrence	1
Lived 9 years, died of uræmia, had jaundice	1
Lived 7 years, died in an automobile accident	1
Lived 6 years, died of pneumonia	1
Lived 5½ years, died from unknown cause	1
Lived 5 years 4 months, died of local recurrence	1
Lived 5 years 3 months, died of recurrence	1
Lived 5 years, died of pneumonia without recurrence	1
Lived more than 5 years, after which was unable to trace	3
2. Patients alive 5 years or more without known recurrence	15
17 years after operation	1
11 years after operation	2
10 years after operation	2
8 years after operation	4
7½ years after operation	1
7 years after operation	1
6 years after operation	2
5½ years after operation	2

SUMMARY

Roughly speaking, it would appear that one doing the radical abdominoperineal operation in two stages may expect an operability of approximately 50 per cent, operative mortality of approximately 10 per cent, and of those recovering from operation approximately 50 per cent of 5-year cures. In a given number of cases of carcinoma of the rectum it seems certain that a larger number of 5-year cures may be obtained by the abdominoperineal operation in one or two stages than by any other method.

PERMANENT CURE OF CANCER OF THE THYROID

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THE past 10 years has seen rapid increase in the number of patients symptom free from cancer of the thyroid following surgery, and an almost proportionately great increase in the number of years in which such patients have remained well. Three factors chiefly influence the permanence of cure in such cases.

1. *Duration of the disease.* This is, of course, an important factor influencing metastasis or local extension to organs of vital importance.

2. *Form of treatment employed.* Irradiation alone; surgery alone; and a combination of irradiation and surgery have been used. The best results have been obtained from the combination of irradiation and surgery.

3. *Type of growth.* Malignant characteristics have developed in practically all forms of growths affecting the thyroid gland. The classification of forms of malignancy differs with almost every writer on this subject. For example: Ewing[1] believes that true sarcoma of the thyroid does not occur; but a considerable number of cases of sarcoma are reported in which microscopic examination was made by pathologists of good reputation. True carcinoma, adenocarcinoma, and growths apparently both clinically and pathologically benign but later giving rise to metastasis and showing other malignant characteristics, have been reported from numerous sources.

The establishment of a diagnosis is indispensable before any statement can be made as to the cure of malignancy. The pathological examinations in my cases have been made at the New York State Institute for the Study of Malignant Disease, Tompkins County Laboratory (Director, B. F. Hauenstein), the laboratories of Cornell University, and in several doubtful cases diagnosis was confirmed by Dr. James Ewing, professor of pathology at Cornell Medical College, New York, and Dr. Joseph C. Bloodgood, Department of Surgical Pathology, Johns Hopkins Hospital, Baltimore.

DOUBTFUL DIAGNOSIS

Many authorities have stressed the great difficulty in classifying these growths and determining which are malignant. There has been a doubtful diagnosis or pathological report in 12 of my patients, stating "suspicious of malignancy." Of this number, 4 have already died and 2 have gone on to develop further trouble requiring operation or irradiation. This experience inclines me to agree with Allen Graham[2] who states that a diagnosis can be made with confidence from cell and tissue morphology in only 30 to 40 per cent of cases; in the remaining cases the microscopic appearance of the tissue cannot be relied upon. "Malignancy depends upon the tendency or capacity of the tumor to invade locally, cause local destruction, recur after operation, give distant metastasis and finally to result in the death of the patient."

Fetal adenomata have been found prone to develop malignancy by a number of writers. Fetal adenoma has been reported on pathological examination in 41 of my recent cases. Two of these patients have later developed symptoms of malignancy, have been treated at the Memorial Hospital, New York, have died, and a postmortem diagnosis of definite malignancy has been made.

Biopsy has been done in only one of my cases by reason of the fact that the public classes even so trifling a procedure as a surgical operation, and in many cases attributes later death to the so called operation rather than to the disease. This is likely to bring surgery into disrepute and it does not furnish information of sufficient value to warrant it. Indeed, in many instances, biopsy seems to increase the rapidity of growth. The patients who have gone on to a fatal outcome, whether having been regarded as having inoperable, hopelessly extensive growths, or whether having been operated upon have been classed as malignant according to Allen Graham's statement.

Fortunately for the patients, a large number of thyroid malignancies may be classed as some form of adenocarcinoma—arising from nodular growths, developing in fetal adenomata, or of papillary form, which is seen most often.

Three factors influence favorable results in the various forms of adenocarcinoma: (1) the slow extension of the growth; (2) late metastasis—this is commented upon by nearly all writers on this subject; (3) radiosensitivity—many recent writers have mentioned the fact that these growths are sensitive to irradiation with radium or X-ray.

CONDITIONS NOT ALWAYS INFLUENCING UNFAVORABLE PROGNOSIS

Several writers have expressed the belief that if a diagnosis of malignancy can be made with

[1]Neoplastic Diseases, 1922, p. 907

[2]Surg., Gynec. & Obst., 1924, xxxix, 781.

reasonable certainty before operation the outlook is almost hopeless. This was not shown to be true in the series reported from Terry's Clinic at the University of California[1], nor has it been in my own experience. A diagnosis of probable malignancy was made before operation in nearly one-half of my cases that have remained symptom free for 5 years or more, although without question the presence of symptoms justifying a diagnosis of malignancy is an unfavorable factor.

Extension of malignancy to the thyroid from growths primary in other structures of the neck also has been given an unfavorable prognosis. There have been 3 such cases in my series including *2 carotid gland tumors* in which the growth had infiltrated a considerable part of the thyroid. One of the patients has remained well 7 years following operation. A branchial cleft tumor[2] with extensive infiltration of the thyroid and other surrounding structures was living over 7 years following partial thyroidectomy, excision of the other involved structures, and irradiation.

Local recurrence following operation generally has been considered too discouraging to warrant secondary operation, although Dunhill[3] has had several cases in which life was much prolonged. Several other surgeons also have reported such experience although the majority of writers consider such cases hopeless. Two successes following excision in recurrent cases have occurred in my series, the one patient living 7 years and the other 5 years after secondary operation followed by radium treatment.

Late metastasis to the lymphatic glands is also evidently unfavorable, but one of my patients is living 10 years after removal of late metastatic involved glands by block dissection. The glands had enlarged and were excised 21 months following partial thyroidectomy. The pathological diagnosis showing the lymphatic involvement to be of the same type of growth as originally affected the thyroid was confirmed in this case by Bloodgood of Johns Hopkins Hospital.

TYPE OF TREATMENT

Radical excision of malignancy was the only treatment in the early days of thyroid surgery and is still the only method used by some surgeons. Many of the earlier operations were extremely radical and the cosmetic results, function, and mortality were all shockingly bad. Radium and X-ray were used at first only in cases thought too bad for surgery and this is still the treatment of many surgeons. It is little wonder that the early results were and many present results of irradiation are unsatisfactory. Over 20 years ago a few began to try the combined treatment of operation, usually less radical, followed by irradiation. In 1922 I reported at the surgical section of the American Medical Association[4] a 10 year cure and one symptom free for more than 8 years. Since that date my number of 5 year cures has increased to 51 per cent of patients in sufficiently good condition to warrant surgery.

Several surgeons may have come upon the use of the combined method independently. In any case it is now recommended by many, including among others, Pemberton of the Mayo Clinic; Portmann of The Crile Clinic; Sir Robert Dunhill and Joll of London; Forssell of Stockholm; Barthels; Holfelder, Strauss, and others among the German writers.

My own experience has been as follows:

Operation only—
  5 year cures—3
  10 year cures—1
Irradiation only—
  No permanent cures
Operation followed by irradiation—
  5 year cures—3
  10 year cures—4
Patients have been living and well as follows:

16 years	1
10 years or more	7
5 years or more	11

Electro-surgery should be used in dealing with all thyroid malignancies. In several earlier papers[5] I have called attention to the facts that radio cutting destroys cancer cells, leaves non-absorbing surfaces, and seals vessels and lymphatics, thus reducing the likelihood of local recurrence and metastasis.

The preventive treatment of thyroid malignancy should be the treatment of the future. Early removal of goiter not only avoids likelihood of malignant change but spares the patient the danger of death from thyroid toxæmia or a damaged heart muscle. My series shows 11 cases in which the goiter had existed 20 years or more before symptoms of malignancy developed, in 7 cases 25 years or over, and in 2 cases over 45 years, before malignant symptoms appeared. It is, of course, impossible that these patients could have survived so long had actual malignancy been present from the onset of the goiter. Early

[1]Ward, Robertson, and Carr, J. L. Tr. Am. Ass. Study of Goiter, 1930.
[2]Tinker, M. B., Surgery of the Neck, Ochsner's *Surgical Diagnosis and Treatment*, 1920, i, 723.
[3]Brit. J. Surg., 1931, xix, 73.
[4]J. Am. M. Ass., 1922, lxxix, 1291–1294.
[5]Tinker, M. B. Surg., Gynec. & Obst., 1931, lii, 508; Ann. Surg., 1931, xciv, 587; Arch. Surg., 1933, xxvi, 705.

removal is indicated in all goiters of considerable size if of many years' standing and recent rapid increase in growth, particularly if hard, fixed, or associated with hoarseness, difficulty in swallowing, and breathing. In a personal observation of over 6,000 goiters I have not seen a single development of malignancy in patients operated upon early and without malignancy being present before operation. Neither have I seen such a case in the work of other surgeons with whom I have been associated, or a report of such cases in surgical literature.

Early operation is the only prophylactic treatment until we have more adequate knowledge as to the causes of goiter and malignancy and their prevention. In the meantime a combination of electrosurgery followed by irradiation, used even in many apparently hopeless cases, gives a highly encouraging number of cures which will doubtless increase with further experience.

FIVE YEAR CURES IN MALIGNANT BONE TUMORS

WILLIAM B. COLEY, M.D., F.A.C.S., AND BRADLEY L. COLEY, M.D., F.A.C.S., NEW YORK

THIS report is based on an analysis of cases treated at the Memorial Hospital and the Hospital for Ruptured and Crippled from 1890 to 1932, and includes 360 cases of malignant operable tumors of the long bones (261 treated prior to November, 1927).

We began to use the toxins of erysipelas and Bacillus prodigiosus in the treatment of inoperable bone sarcoma in 1893, and soon after that used them in operable cases as a prophylactic after amputation. Our first successful result in bone sarcoma occurred in a spindle cell sarcoma of the metatarsal bone. Amputation had been performed by Dr. William T. Bull in 1890; the disease recurred in the stump, and a tumor the size of a child's head appeared in the popliteal region. The disease was held under control for 6 months by the toxins of erysipelas and Bacillus prodigiosus, but later further increase in size was noticed. A hip joint amputation was then performed. This was followed by an inoperable recurrence in the gluteal region. Under toxin treatment alone all evidence of the disease entirely disappeared, and the patient remains well at the present time, 39 years later.

The first case in which we succeeded in saving the limb occurred in an extensive osteogenic spindle cell sarcoma of the tibia (1896). The diagnosis was confirmed microscopically by Dr. John Caven, professor of pathology, University of Toronto. An amputation had been advised by a number of surgeons. The patient recovered under toxin treatment alone, possibly aided by an attack of accidental erysipelas that had developed near the end of his treatment. He was still well, with a useful limb, 30 years later.

In reviewing our 5 year recoveries we find that many of the earlier cures from toxins alone occurred in the so called round-cell sarcoma group, in which the disease originates chiefly in the shaft of the long bones. These cases would now be classified as endothelial myeloma or Ewing's sarcoma. This group has hitherto shown the smallest percentage of cures of all types of bone sarcoma.

Before citing our results it is interesting to note that Kolodny[1], in a critical study of all the material of the Registry of Bone Sarcoma up to 1927, with reference to *therapy*, stated: "The question of therapy is still awaiting an answer. It is a strange fact that with all our knowledge of the minute details of the histopathology of bone tumors the progress along the practical therapeutic road is almost in the same stage that it was in some 50 years ago. As a rule malignant bone tumors are fatal, and we know of no therapeutic method to prevent death from this disease."

In view of the recent trend toward irradiation[2] for the treatment of bone sarcoma, we shall cite first our results in a large series of osteogenic sarcoma (169 cases) treated by this method. Radiology, November, 1933.

Of 129 cases of primary operable osteogenic sarcoma of the long bones treated by irradiation alone, there were no 5 year recoveries. Six cases in which amputation or resection was employed in conjunction with irradiation have remained well for 5 years. Of 39 cases in which irradiation was combined with Coley's toxins, there were 4 five year recoveries, in 2 of which amputation was employed.

These statistics are confirmed by those of the Registry of Bone Sarcoma as cited in a personal communication from Doctor Crowell in 1932. Up to that time there were only 2 five year recoveries of osteogenic sarcoma by irradiation alone. Only 1 of these was a long-bone case in which there was no microscopical confirmation of the diagnosis, in fact some of the Committee on Bone Sarcoma had regarded it as a possible myositis ossificans.

We have another group of 217 cases in which amputation was performed. The results are as follows: Of 15 cases treated by amputation alone, there were 2 five year recoveries (1 died 7 years later). Of 98 cases in which amputation was performed after prolonged irradiation, there were 5 five year recoveries. Of 23 cases in which amputation was performed after prolonged irradiation combined with toxins, there were 2 five year recoveries. Finally, and most important, of 61 cases treated by amputation and toxins without preliminary irradiation, there were 24 five year recoveries.

These results caused us in 1928 to abandon primary irradiation in the treatment of osteogenic sarcoma of the long bones, and to substitute immediate amputation followed by toxins.[3]

[1]Kolodny, A. Bone Sarcoma. Surg., Gynec. & Obst., 1927, April.

[2]Coley, W. B. Treatment of osteogenic sarcoma by irradiation. Radiology, 1933, October. The treatment of sarcoma of the long bones. Ann. Surg., 1933, March.

[3]This is the method which I had continued to use in practically all of my private cases even after the Memorial Hospital staff had decided to try irradiation as a routine measure.

The most notable improvement in results is found in our group of femur cases which up to July, 1933, comprised 159 cases of sarcoma of the femur (120 osteogenic and 39 endothelial myeloma).

Of 110 cases of sarcoma of the femur (83 osteogenic and 27 endothelioma) observed prior to 5 years ago, 23 or 21 per cent have remained well for 5 years or more (12 osteogenic and 11 endothelioma).

Of the 12 osteogenic 5 year cures, 9 were treated by amputation and toxins, and 3 by prolonged irradiation and amputation. Of the 11 endothelioma 5 year cures, 6 were treated by toxins alone, 3 by toxins and irradiation, and 2 by amputation and toxins. In 2 of the endothelioma group, there was no microscopical confirmation of the diagnosis but the clinical and roentgenological evidence (extensive involvement of half of femur, beyond hip joint amputation) left no reasonable doubt of the correctness of the diagnosis of endothelial myeloma.

In 105 cases amputation was employed as follows: 12 treated by amputation alone, with no 5 year cures; 48 treated by prolonged irradiation and later amputation, with 3 five year cures; 45 treated by amputation and toxins, with 13 five year cures. These results are of special interest when we reflect that Butlin's series of 68 cases of periosteal sarcoma of the femur treated by high- or hip-joint amputation alone, contained no 5 year cures—only 1 patient remained well for 3 years.

In 7 of our femur cases the limb was saved.

Summary of 5 year recoveries. For details see accompanying table. Suffice it to say, of a total of 261 cases of malignant sarcoma of the long bones treated prior to November, 1928, 56 or 21.4 per cent have remained well for 5 years or more. Thirty-four were classified as osteogenic sarcoma, and 22 as endothelial myeloma. Coley's toxins were used in 47 of the 5 year cures. Fifteen cases were either inoperable when the treatment was begun or had become inoperable during the course of treatment. The limb was saved in 21 cases (12 endothelial myeloma and 9 osteogenic sarcoma).

In addition we have 22 five year recoveries of inoperable sarcoma of the flat bones (14 osteogenic and 8 endothelial myeloma). The toxins alone or combined with irradiation were used in every case.

Of the entire group of 48 osteogenic sarcomata well 5 years, it is interesting to note that 27 were accepted by the Registry of Bone Sarcoma. The remaining 21 unregistered cases were treated many years ago; their microscopic sections were lost; but in every case the diagnosis was confirmed by the leading pathologists of the country, and the clinical and often roentgenological evidence was positive in all.

FIVE YEAR CURES, MALIGNANT BONE TUMORS

Osteogenic sarcoma of long bones—5 year cures—microscopical examination in all

Method	Cases
Amputation alone	2
Coley's toxins alone	4
Toxins and amputation	16
Toxins and irradiation	5
Prolonged X-rays, later resection (humerus)	1
Resection (humerus) followed by radium	1
Total	34

Osteogenic sarcoma of flat bones—5 year cures—microscopical examination in 13

Coley's toxins alone	9
Toxins and irradiation	5
Total	14

Endothelial myeloma of long bones—5 year cures—microscopical examination in 17

Coley's toxins alone	6
Toxins with amputation or resection	9
Toxins and irradiation	6
Irradiation alone	1
Total	22

Endothelial myeloma of flat bones—5 year cures—microscopical examination in 5

Coley's toxins alone	4
Toxins and irradiation	4
Total	8

In the 9 cases in which there was no microscopical examination, the clinical and roentgenological evidence (large, far advanced, inoperable tumor, condition hopeless) left no reasonable doubt of the correctness of the diagnosis.

In 6 of the 78 five year cures, the patient later died of the disease. These were all in the *osteogenic* group, and were as follows:

Locality	Treatment	Died—years later
1. Humerus	Toxins, amputation, toxins	8
2. Femur	Irradiation, toxins, amputation, toxins	11
3. Ilium	Toxins	5
4. Skull	Toxins and irradiation	7
5. Tibia	Amputation alone	7
6. Sacrum	Toxins	7

In his brief summary of the cases at the Registry of Bone Sarcoma, Doctor Crowell, at the meeting of the American College of Surgeons in 1932, stated that up to that date there had been registered 655 cases of osteogenic sarcoma, with 59 or 9 per cent 5 year cures.

The only rational explanation of the marked improvement in our own series is that the toxins of erysipelas and Bacillus prodigiosus were used in the great majority of the 5 year cures.

The old objection often offered that I am the only one who can get good results with the toxins

has been proved definitely to be without foundation in fact. Some of the most brilliant results with the toxins have been obtained by other men. Among these I would mention the cases of Lilienthal[1] as well as Christian and Palmer[2]. Both patients were hopeless, inoperable bone sarcomata with multiple metastases to bones and soft parts. Both made a complete recovery under toxins alone and are well, one 9 years later, and the other 8 years later. The diagnosis in both cases was confirmed by the leading pathologists.

Bloodgood has stated that the Johns Hopkins statistics show no case of bone sarcoma with verified diagnosis well 5 years following any method of treatment. Our series show 18 cases treated prior to 1913 well from 5 to 39 years. In addition there are 9 other cases treated with Coley's toxins by other surgeons; one received X-ray in addition; all are well from 6 to 20 years. There was a verified diagnosis in all 27 cases.

CONCLUSIONS

A study of these results I believe justifies the conclusion that the present pessimistic attitude regarding the prognosis of malignant bone tumors is without foundation in fact. As I have frequently stated, the prognosis depends largely upon an early diagnosis and a wise choice of treatment.

For osteogenic sarcoma, especially the type associated with marked new bone formation, I advise immediate amputation without preliminary irradiation as soon as the diagnosis has been established. In order to lessen the chances of a recurrence, Coley's toxins should be given as a prophylactic for a period of from 3 to 6 months.

While endothelial myeloma is highly sensitive to both toxins and irradiation, rarely has the disease been controlled by irradiation alone. On the other hand, the use of the toxins alone, or toxins combined with irradiation, has resulted in a large number of 5 year recoveries even, in some instances, after the disease had reached the inoperable stage and had developed metastases. I believe that a combination of the systemic effect of Coley's toxins plus the local effect of irradiation offers the greatest hope of saving the patient's life as well as his limb in this type of tumor. Early amputation followed by prolonged toxin treatment would, undoubtedly, give a higher percentage of 5 year recoveries, and for this reason it is well to let the patient have a voice in the final decision as to the method to be employed.

[1]Lilienthal, H. Mediastinal sarcoma — treated by Coley's fluid. Ann. Surg., 1927, April.

[2]Christian, S. L., and Palmer, L. A. Military Surgeon, 1927, lxi, 42; Am. J. Surg., 1928, lv, 188.

SYMPOSIUM: TREATMENT OF FRACTURES

THE ACCOMPLISHMENTS AND IDEALS OF THE REGIONAL FRACTURE COMMITTEES

CHARLES L. SCUDDER, M.D., F.A.C.S., BOSTON

THE American College of Surgeons is 20 years old. The Committee on Fractures of this College is 12 years old. I am asked to tell in 15 minutes what has been accomplished in 12 years' devotion to a superb ideal. This is impossible. However, I will indicate certain phases of the work of the Committee on Fractures.

The past, the present, and the future activities of the committee are indivisible, not separable, but connected parts of a whole. The past is an intimate part of the present. Upon the performance of the past and present depend to a very large degree the accomplishments of the future.

The objects of the College are to advance the science and art of surgery and to assist in the better instruction of doctors. The objectives of the Committee on Fractures are very much like those of the College itself—to acquire knowledge of the pathology of fractures, to improve the art of treatment, and to furnish all doctors with an understanding of safe and effective treatment. Poor results from fracture treatment led to the formation of the committee. There could be no more sound basis for the establishment of such a committee than the recognition of the evils attending the treatment of fractures.

To give you an idea of the magnitude of the fracture problem today it is only necessary to remind you that there were in the United States in one year (1932) upward of nine million accidents and over one million fractures. To assist in the preparation of doctors for the proper care of this huge total group of fractures is no mean task. It is a task worthy of tremendous effort.

The Committee on Fractures having its own ideas of the details of treatment, established groups of doctors in different parts of the United States and Canada (voluntary groups of medical men) to carry on in fracture work. These regional groups now number 29 and have about 300 members.

The regional committees were organized to keep in touch with the various problems connected with fractures in their several communities. Each community is different from every other, hence the regional committees have concerned themselves with a variety of things. They are in close touch with the Committee on Fractures, the local hospitals, with each other, and with neighboring doctors. These contacts make it possible to work for the better handling of fractures.

If the accomplishment of these groups should be detailed to you it would appear what really marvelous things have been done in arousing a deep and intelligent interest in fractures—in dissipating many local jealousies—in making for a solidarity of effort which once would have been considered impossible. The regional groups are active. Inventories of hospitals have been made to determine the fracture status; responsibility for fracture treatment has been established; the hospital clinical material has been employed for teaching purposes; meetings have been arranged with state, county, and town organizations to further a knowledge of sound treatment; special demonstrations of fracture treatment have been made at stated meetings for the medical profession. Pay courses in the treatment of fractures have been sponsored successfully. Round table discussions of fracture problems and individual cases have been held. There have been exchange hospital clinics in neighboring towns. First-aid clinics are organized for firemen and highway patrolmen. Apathy and lack of interest in fractures has given place to a really lively and enthusiastic concern for the best forms of treatment. The perfunctory care of compensation cases is being displaced increasingly by a real co-operation of the doctor and the injured patient.

For 12 years through these regional groups the committee has been at work within the profession. Most surgeons are in sympathy with the aim of this committee. The practicability of the regional group method in furthering the sound treatment of fractures has been demonstrated. The experiment has been a success.

During these 12 years certain changes in the understanding of fractures have occurred—the operative direct approach as an initial method has come to be safeguarded; the effect of injury upon the individual personality and its relation to recovery are better understood; the recovery of the usefulness of the injured part is regarded as more important than the fracture itself; consultation is more and more being sought by doctors in serious cases; the relative values of the different forms of traction, whether manual, adhesive plaster to skin or skeletal have been estimated; the proper use of the plaster-of-paris splint is established, early movement has taken the place of immobility. Fractures of the skull have been interpreted in terms of the physics and physiology of the intracranial circulation.

It is impossible ever to standardize the treatment of fractures just as it is undesirable and impossible to standardize the treatment of any disease. The Committee on Fractures makes no attempt to do this. It has been interested in a simplified, not a standardized, treatment. The work of the regional groups has been fostered by the committee. Constant personal contacts have been maintained, sympathetic communications have been exchanged—this has continued for 12 years—until today we find a co-operative surgical spirit, a desire to help the furthering of information on fractures. Desultory lack of concern has given place to an aroused interest in present practice and ideals.

Along with this gradual development of professional interest in fractures there has been developed the Hospital Standardization movement. The movement to standardize hospital equipment and organization is 15 years old. It is without doubt the finest achievement of the American College of Surgeons. It aims primarily at establishing and maintaining a proper environment in the hospital for the doctor, so that the most scientific service may be rendered—it affords the patient the greatest benefits that medical science can offer.

The Committee on Fractures having studied the fracture situation from all angles and in all its phases, having kept in touch with the latest and best in treatment for the past 12 years, having through its regional groups maintained contact with many doctors in different parts of the country, believes that after these experimental years it is in a position to carry on still further. The standardization of hospitals makes possible an immediate forward move. The organization of the hospital as now established offers a splendid setting, a suitable environment for pushing to the limit the program of the Committee on Fractures. The ground is prepared, the setting is there for the establishment of regional groups throughout the country.

At precisely this juncture the committee has had the vision to see that proper transportation of the injured is the most important requirement for the beginning of sound fracture treatment. There are few places in the United States and Canada where the patient has the benefit of such safe transportation. The Committee on Fractures proposes to continue intensively a campaign for establishing as rapidly as possible the use of fixed traction plus immobilization in the transportation of injuries to the long bones. The launching of this move has already met with success in New York and in Philadelphia. All ambulances are equipped for proper transportation. This move should be extended to every part of the United States and Canada.

To this end and to facilitate and carry on the work of the committee as outlined above we need to form 21 new regional groups. Then we shall have a total of 50 regional groups. By the formation in due time of subgroups, between regional groups, the entire country will be represented and accessible to the Committee on Fractures. We have an ideal, a strategical objective, and we have a clear strategical plan in the formation of regional groups. And we need a continual personal supervision of all these groups.

The quality of the work done by the local doctor determines the success or failure of the standardization movement in hospitals. In any institution the kind of treatment given and the results obtained are the measure of the rank of that particular institution. We seek by means of regional and sub-committee groups in all communities throughout the country to reach directly the doctors of those communities both within and without the graded hospitals. It is the doctor we are influencing, directly, not indirectly.

The results of fracture treatment are better than ever before but my knowledge of the conditions existing in various parts of the country leads me to believe that in every town we need more men qualified to treat fractures. There are too few who are qualified. We seek to reach the practitioners who are and always will be obliged to treat fractures in the first instance. There is a too prevalent satisfaction in the profession with mediocre results. The personnel must be improved before the proper organization can be successfully furnished to industry.

The work of the Committee on Fractures is the most important thing in surgery today. It

touches all classes including industry. It is a hitherto neglected field. This may sound extravagant, but if it is realized that in almost all other special branches of surgery—like genito-urinary surgery, gynecological surgery, gastro-intestinal surgery—each has its existing organization, it will be seen that fracture surgery, having no organization outside the College, must depend upon the College for its development. The consummation of the plan of the Committee on Fractures will bulk large—the hospitals are ready and waiting for surgeons skilled to carry on above all criticism in fracture treatment. The community is waiting for trained men. Communities are in need of men trained to care for fractures.

The College will do well to make an immediate move in furthering this plan of the Committee on Fractures so as to provide contacts through regional and subgroups in all corners of the United States. We have undertaken a big problem. The growth of the plan has been gradual as you know. The standardization of hospitals has prepared the way. The total expense of carrying out this plan of the committee is relatively slight —once it has been established its supervision is essential.

The results of such a plan will redound to the glory of the College. It will rank as second only to the Standardization of Hospitals. I ask your co-operation.

THE AIMS OF MEDICAL EDUCATION IN IMPROVING THE TREATMENT OF FRACTURES

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A PATIENT who has had an extensive gall-bladder operation will probably be back at work within 2 months. Yet if that same patient receives a fracture of the femur from an automobile accident it will be over a year, under good medical care, before he can regain his normal economic efficiency. If, however, he receives indifferent treatment this time may be prolonged indefinitely. Hitzrot of New York, in a review of 96 cases of fracture of the femur in the age group between 15 and 40 years, reported that only 4 had completely satisfactory results, while the remainder had to be given industrial ratings from 60 to 100 per cent disability. The average length of time that they were kept from returning to their normal occupation was 14 months.

Twenty years ago the majority of fractures occurred in industrial plants and were well cared for by industrial surgeons. Today any practicing physician may have to give first aid treatment for fractures due to automobile accidents. The length of disability from these accidents depends very largely on the emergency first aid treatment. If the patient is hurriedly placed in an automobile, with a jackknifing of the fractured bones, the trauma that results therefrom may do more harm than the initial injury. Any surgeon working in a hospital along automobile highways can tell you of the increasing number of fractures brought in with overriding of the fracture ends due to insufficient splintage. A critical visitor may find in many hospitals fracture cases that have not received the best treatment while under observation. It takes eternal patience, infinite attention to detail, a knowledge of physics, anatomy, and pathology to treat a fractured limb.

What are our under-graduate and post-graduate schools doing to meet this problem and what can we, as Fellows of the American College of Surgeons, do to remedy the faults?

The Sub-Committee on Medical Education in its 1932 report states:

> Most of the medical schools of the country have reduced the number of hours in their under-graduate curriculum. As a result, in many fields of medical work the under-graduate instruction has become of necessity limited very largely to a thorough understanding of general principles followed by an opportunity to apply these to individual cases under the direction of a teacher.

Theoretically this method is good, but it often fails in the practical application. This is particularly true in our courses in fractures. We are turning out students full of theories, but lacking in clinical understanding which enables them to put the theories into practice. Didactic lectures do not take the place of clinical observation.

Insufficient stress is laid on the art of general palpation and the eliciting of bone tenderness, and, if I may be heretic enough to say it, I believe too much attention is paid to radiology. If a student, when he becomes a practitioner, moves to the country, the delay encountered in obtain-

ing X-ray pictures in order to make his diagnosis may be disastrous for the patient. The best time to reduce a fracture is before œdema or hæmorrhage occurs between the muscle fibers, creating spasm and overriding. If the student were taught to recognize and diagnose a fracture and to depend on inspection and palpation rather than on X-rays, he would then in practice reduce the fracture immediately and later transport it for X-ray as a check-up.

The consensus of the members of the Committee on Fractures is that the training of the students in fractures should start with a broad knowledge of the pathology of fracture and the process of bone repair. I have found that a student can learn more from the simple experiment of fracturing an animal's leg under an anæsthetic and then making an inspection of the gross pathology several hours after fracture than in almost any other way. He sees the overriding of the fragments, the hæmorrhage and œdema between the muscle bundles, bulging them out so that even with severe traction post mortem it is difficult to create an anatomical reduction. While many men still differ in their theories of the cellular elements involved in fracture healing and in the chemical changes that take place, there are certain known facts in fracture healing which are essential. It is generally acknowledged that, following a fracture which may traumatize muscles, vessels, and nerves, hæmorrhage immediately occurs. In 4 or 5 days, granulation tissue is observed about the ends of the fractured bones. Calcification occurs in this initial granulation tissue, forming the provisional callus. If too much motion is present the granulation tissue will be inhibited. One must also recognize that if the means of immobilization are applied too tightly, it will be impossible for granulation tissue and capillaries to penetrate the fibrin about the fractured ends. If healing is not interfered with, bony union occurs by definite ossification taking place along and through the planes of the initial callus.

This basic knowledge will give the student an understanding of the factors with which he is dealing. He is also given a mental picture of what is going on when he is reducing a fracture and of the factors to be considered in applying a cast or traction so that, from the point of view of circulation and position, the bone ends will have the best chance to unite.

Students frequently complain that their instruction deals with the handling of fractures by experts in large and intricately organized institutions but fails to deal with the problem of the average practicing physician confronted with a fractured shaft of the femur in a patient's home. This complaint is well worth heeding.

A student should, if possible, be allowed to see a fracture patient throughout the course of his disability, as this will enable him to study the patient as a whole and to appreciate that, contrary to previous theory, the general physical condition of the patient has little bearing on his ability to produce callus; that the anatomical position of the fracture is of greatest importance, for if it involves the circulation of the part and interferes with the proper nutrition of the bone, non-union is very likely to occur. He must also learn that to be successful the treatment must be adapted to the patient's age, his mental and emotional make-up, his physical condition and his economic status, before the actual care of the limb involved can be planned. This means that the student cannot safely learn didactic rules as to the treatment of specific types of fracture.

The average student, and indeed many surgeons, know the term physical therapy, and consider referring a patient to physical therapy when they have nothing better to do. Many students have never seen the inside of a physical therapy department. They know a few terms, such as massage and baking, diathermy, and radiant lamp, but have no actual conceptions of either their real advantages or limitations. Therefore, a thorough grounding in the principles of balanced exercises and the proper use of electrical appliances is essential. The doctor can really do little in making a callus form—that is the patient's job—but his responsibility does not end until the patient has a leg or an arm whose function has been restored to as near normal as possible.

In view of the fact that the time for the study of fractures is limited in the schools, there is a definite need to make up for this by more carefully arranged instruction for internes. This should begin with the ambulance surgeon, as he is the one usually called upon to give first aid. Through the efforts of the New York and Brooklyn Regional Fracture Committee, the Commissioner of Hospitals was persuaded to pass an ordinance requiring all ambulances to carry Thomas splints. But this is only a small part of the story, for as yet no provision has been made to give instruction to the internes in the use of these splints or, for that matter, in any of the principles of first aid handling of fracture cases. All general hospitals should have if not a fracture service at least a staff member qualified to supervise the fracture cases and to instruct the internes. This instruction can be accomplished

through round table discussions of general principles and bedside observations for the study of individual problems. It is with the application of the theories learned in school that the interne should begin to get the realization that each case is a brand new problem and must be handled accordingly, that no one rule can be laid down for the treatment of all fractures, and that the treatment must be selected with due regard to the temperament of the patient, the experience of the surgeon, and the equipment with which he has to work.

The interne should have instilled into him the principle that all fractures are emergencies and that the most valuable period from the point of view of a good result is lost if the immobilization and reduction of the fracture is not done as quickly as possible.

So frequently is the first aid care of a fracture put in the hands of the general practitioner that one of our essential requirements is to give more opportunity to the graduate student to refresh and increase his knowledge in the treatment of this condition.

In 1931 Dr. Cohn reported on Graduate Teaching as follows:

> Through the courtesy of Dr. Rappleye, I got a list of the various schools in the country which have post-graduate medical courses, and to the deans of these colleges letters were written, and to my utter amazement I found that very few of the post-graduate schools in the United States were giving definite courses in fracture instruction. A few universities offered definite fracture instruction—including Pennsylvania, New York Post-Graduate, Harvard, and Yale. In Pennsylvania there is a graduate course of 2 years. At Boston a fracture course is offered each year at the Massachusetts General Hospital. This is an intensive course lasting ten days and the subject of fractures is covered from every possible angle. It is my impression that there are too few colleges giving intensive courses for practitioners interested in such instruction, too few men who graduated from college who are giving special attention to it, and I think one of the most valuable pieces of work is to disseminate information through intensive courses in various parts of the country at our best medical colleges.

It is the hope of the Committee on Fractures that there will be before long sufficient regional groups in the cities in the United States and Canada where the younger man may receive fracture training and where graduates may go to receive stimulation and instruction. In the larger municipal hospitals the younger men are assigned to treat fractures. As they do not have to be members of the College to enter the regional fracture groups, they receive instruction and stimulus throughout the year without expense. In addition, the personal contact they make with the older men is of great importance. Certain regional groups have given concentrated practical fracture courses over a period of a week or longer. At the meeting of the American College of Surgeons in New York the regional group gave practical demonstration of the emergency treatment of fractures. At the present meeting in Chicago the local group is giving splendid demonstrations of an educational nature. The reprinting of the Committee's "Outline of the Treatment of Fractures," in a much improved form, will create an increasing demand for it from practitioners throughout the country. This will aid in the educational propaganda.

And, finally, I heartily concur with the conclusions of the Sub-Committee on Medical Education read before the annual meeting of the Committee in 1932, which were:

"It is therefore recommended that:

"1. Even greater stress be placed on instruction in the pathology of fractures, the process of repair, and the broad general fundamental principles of treatment.

"2. Each hospital, whether it contains a special fracture service or not, appoint someone who shall be responsible for the training of internes in the treatment of fractures.

"3. Wherever possible, opportunities for continued education for graduates in medicine be established both in teaching hospitals and under the auspices of the various medical societies."

THE TRANSPORTATION OF EARLY LONG BONE FRACTURES

The Co-ordination of the Activities of the Committee on Fractures of the American College of Surgeons with (a) The American Red Cross, (b) The American Railway Association, (c) Ambulances and Morticians

ROBERT H. KENNEDY, M.D., F.A.C.S., New York

DURING the late war a method of fixed traction with the Thomas splint was devised for transporting from the front lines those who had sustained long bone fractures. It promptly became a recognized routine in the various armies and everyone agreed that the method was life saving. It was as promptly forgotten as soon as the members of the Medical Reserve Corps disbanded. In isolated instances, however, its use was continued in civilian practice where it was found to be of equal value as in the army.

Estimates of the number of fractures occurring annually in this country vary between 1,000,000 and 1,500,000. The use of the automobile makes their occurrence country wide. Fractures of the long bones account for at least one-third of this number. The necessity for the application of traction before transporting a person with a fracture is attested by all those who have tried it. No one has the right to allow a patient to be moved from the site of accident without proper protection against further injury and increased shock when a simple, practical device to guard against this is available. The Committee on Fractures of the American College of Surgeons is unanimously in favor of the use of fixed traction before transporting long bone fractures.

In the summer of 1931 the Committee on Fractures appointed a subcommittee on "ambulance equipment." Its aim was two-fold—to devise some workable ambulance standard for the emergency care of fractures and to find means of getting the adoption of this standard treatment by the various organizations who first see fractures, namely, hospitals, first aid groups, police and fire departments.

At the meeting of the general fracture committee in January, 1932, a summary of the requirements for a standard application of emergency traction was adopted.[1] It is believed that the details of the method of application may vary according to local conditions.

A plan of procedure to obtain general adoption of the method was also outlined. This included obtaining the co-operation of medical schools, regional fracture committees, medical societies, and hospital superintendents, as well as the preparation of a motion picture film and necessary additions to "An Outline of the Treatment of Fractures." We believed at that time that our main problem was concerned with hospitals and hospital ambulances. Further investigation showed that our original plan of procedure was inadequate and that we must obtain the co-operation of other groups.

During 1932 an investigation was conducted throughout the country to determine who controlled the ambulances which brought the injured to hospitals. A questionnaire was prepared by the subcommittee and sent out by the American College of Surgeons to the chairmen of the various regional committees.

The replies were more than satisfactory in number, and surprised most of us in what they revealed. Ambulances are controlled by hospitals in less than one-third of all instances. This hospital control seems to be most common in the larger cities of the Atlantic seaboard and exists but rarely in other parts of the country. Municipal control through the police or fire departments or through a central receiving hospital forms about 15 per cent of the total. Industrial firms equipping their own ambulances account for less than 10 per cent. The major portion of the ambulances which transport injured persons are controlled by the funeral directors. If accurate and complete figures could be obtained, I believe that over 50 per cent of all ambulances would be found to be thus controlled. Appreciation of this fact necessarily changed our method of approach.

Traction splints were applied in the army by the enlisted personnel to those requiring transportation. Evidently to make the method available in civilian life we must depend on the training of various lay groups. This means that we must have the co-operation of all the Fellows of the American College of Surgeons. Those who at any time come in contact with fracture patients in their hospital affiliations must promote this transportation work among the laymen in their communities. Of all the ambulances of which we received reports, only 15 per cent carried traction splints. In general the questionnaire was sent to

[1] Kennedy, R. H. Bull. Am. Coll. Surg., 1933, xvii, 25.

selected groups and I believe this percentage is far higher than would be an accurate figure for the whole country. Contacts have already been made with some of the groups concerned and some progress has resulted.

The general fracture committee has a subcommittee on education. Following the recommendation of this subcommittee the College has sent to the professor of surgery in each of the medical schools in the United States and Canada a memorandum entitled, "Suggestions for Undergraduate Instruction in the Emergency Treatment of Fractures of the Long Bones." If this is followed, the problem of training those recent graduates in medicine who become ambulance surgeons will be much simplified and all graduates in medicine will be sent from their schools with some idea of the need, practicability, and advantages of fixed traction in transportation.

"An Outline of the Treatment of Fractures," published by the American College of Surgeons was revised in 1932. In this edition there was added a detailed description of a typical application of emergency traction for fracture of the shaft of the femur.

More than 2 years ago the co-operation of the American Red Cross was obtained through Judge John Barton Payne, national chairman of that organization. An invitation was presented to and accepted by the Committee on Fractures to assist in a revision of the fracture material in the Red Cross textbook. When the subject of transportation in fixed traction was brought up the representative from the Red Cross stated that he believed the use of special splints and supplies for application of the method made it impractical in their first aid work. We then devised for the Red Cross a method of application in which only such supplies are used as are ordinarily recommended in their manual, except for the Thomas splint. This method is fully described and illustrated in the new "American Red Cross First Aid Text-Book," which appeared in April, 1933. To quote from this book:

"Groups that control and carry their own supplies will find it very satisfactory, and its application is not hard to learn. Such groups include emergency rescue and ambulance squads of metropolitan fire and police departments, volunteer fire departments, state highway police, certain industrial plants, and certain highway first aid stations. It is here suggested that instruction in its use be given only to such groups as are listed above, and be omitted from the general First Aid Class." Instruction is actually being given by them to the groups mentioned and we hope and expect that they will find this method so practical that before another edition of the book is printed they will deem it necessary to give this instruction to all their classes. It is of interest to note that over 500,000 individuals were instructed in first aid by the American Red Cross.

The American Railway Association through its medical and surgical section, made up of the chief surgeons of the various railways, between 300 and 400 in number, has a permanent fracture committee. The relations of this organization, as well as the Association of Railway Claim Agents, with our fracture committee are most cordial. For several years one or more of these chief surgeons have been active members of our fracture committee. At the 1932 meeting of the Committee on Fractures the chief surgeons of two railways and the claim agents of two railways addressed the committee. At the 1932 convention of the medical and surgical section of the American Railway Association three members of the Committee on Fractures presented papers. One of these was on the use of traction in transportation and included a demonstration by an ambulance team of a method of application of such splints in fractures of the arm and leg. Much interest was shown, but progress here cannot be rapid. The organization acts in an advisory capacity only and changes must come through one of the vice-presidents in the operative department. There are about 10,000 railway surgeons and the mileage to be covered by Thomas splints is quite extensive. Naturally in the present financial state the railways are making no new commitments. It is of interest to note that at the 1933 convention of the medical and surgical section of the American Railway Association the following report was adopted:

"During the current year the American College of Surgeons has issued a new edition of "An Outline of the Treatment of Fractures" which contains improvements on previous editions and your Committee recommends this to our members for distribution among their surgical staffs as we think it contains material of great value to the average surgeon."

Our committee includes two medical officers of the regular army. In the United States Army systematic instruction of the enlisted personnel in the application of fixed traction has been continued since the war. We are indebted to these officers not only for their enthusiastic interest, but for many improvements in the Army traction method, making it more effective and safe for long distance transport or over rough country. Also their work is a constant reminder of the

simplicity of training large groups of laymen in such a method.

In many cities policemen or firemen man the ambulances or have emergency rescue squads. Last year one of the members of our committee was president of the International Association of Police and Fire Surgeons. When this plan was first discussed with him he said that he believed that it was impractical, at least for fire rescue squads. On further investigation he became one of the most enthusiastic workers for its adoption. He personally trained the squads under his control and then had a motion picture prepared which shows his men actually applying these splints to upper and lower extremities. The first public showing of the reel was at the convention of police and fire surgeons in Montreal. It brought quick results in that there was an immediate demand from other chief surgeons for training of their men. Several copies of this reel have already been made and are in use in various parts of the country.

The campaign to enlist the co-operation of the funeral directors is still in the formative stage. Contact has been made with their two national organizations and both are interested. They felt, however, that definite printed instructions concerning the method would have to be submitted to the individual funeral directors before any decision as to adoption could be made. A paper was therefore prepared which was published in the June issue of the *Bulletin of the American College of Surgeons* under the title, "Transportation of the Injured." The Director-General plans to issue this as a reprint which can be submitted to the funeral directors and similar groups. We hope to have this part of the work well under way within another year. Already one large private ambulance company in New York City is equipped with traction splints, and the regional committee of Arkansas reports that two chief funeral ambulance companies are similarly equipped. Each of us can be of great assistance in this part of the work by having knowledge of the method and insisting that our patients have these splints applied before transporting them. The private owner of an ambulance cannot take the responsibility for this procedure in the case of an injured person unless he has the support of the surgeon who takes charge of the patient.

In some states much interest is being shown in the development of first aid work by the Highway Patrol. The Regional Fracture Committee of Arizona has adopted a proposal that an effort be made to secure adequate fracture equipment from the American Red Cross for highway first aid stations and that the regional committee be responsible for the training of first aid men. This equipment would be located at certain automobile filling stations. Minnesota has also given considerable thought to development of this phase of fracture treatment.

Some regional fracture committees have had marked success in furthering this campaign. Through the efforts of the New York and Brooklyn group the Commissioner of Hospitals issued an order a year and a half ago that all ambulances in Greater New York, 116 in number, must carry Thomas splints. In Philadelphia a fine piece of work has been accomplished in instructing the hospital staffs of that city and neighboring communities. The Boston regional committee has proposed a teaching clinic where men throughout New England may receive instruction in proper transportation. The regional committee for Arkansas is urging that all ambulances be adequately equipped with first aid apparatus for fractures. We need more regional committees in order to further this work. Also the time has arrived when each group should reach out into the outlying places to improve fracture transportation. It would seem that the members in large cities cannot properly assume this responsibility without interesting themselves in the surrounding territory. The problem is nationwide, requiring interested individuals in the country side as well as in the cities. It is difficult to imagine that even then the work will not go slowly, unless it is possible to have a field representative who will constantly supervise instruction and arouse and maintain interest throughout the continent.

We believe that the Boy Scout, Girl Scout, and Camp Fire Girls organizations offer a large field in the promotion of this public service.

Thus is illustrated, in brief, the necessity of this work, the widespread character of the contacts we have made and hope to make, and a few examples of what has been accomplished. Results will depend on individual work in each community and along every highway. The Committee on Fractures will gladly assist with advice from experience gained in other communities. The individual surgeon can best know those who are responsible in his town for ambulance transportation, whether it be hospital, municipal authority, or private owner. He alone can learn where pressure can be brought to bear to accomplish quick and efficient results. Fracture management in this country is by no means limited to the surgeons. We seek the presentation of this subject at meetings of local, county, and state medical societies in order that all may appreciate its

need, practicability, simplicity, and value. We hope that shortly the American College of Surgeons will be able to lend motion picture films depicting the method. Only by the demand of the general medical profession for its use can the layman be expected to co-operate.

At your hospital is traction applied to an extremity fracture as soon as the patient arrives in the emergency room, if traction has not been applied before? If your hospital has its own ambulance, are your internes trained to apply traction before the patient is moved from the place of injury? If patients are brought to your hospital by municipally controlled or privately owned ambulances are you willing to be responsible for a simple fracture becoming compound in transit when a layman can be trained to apply a simple and recognized method to prevent this? If you or a member of your family are unfortunate enough to be in a highway accident do you wish the fractured femur to be "jackknifed" in the rear seat of an automobile for a twenty mile drive when highway first aid stations equipped with traction splints might be available? The application of these splints can make transportation in any automobile feasible in comfort and without added injury. We implore your assistance in helping us to solve this problem of the saving of life and limb by popularizing this method of fracture transportation.

CONDUCT OF AFTER-TREATMENT TO PREVENT DISABILITY IN FRACTURES

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THE problem of after-treatment of fractures hinges largely upon the type and time of the primary reduction. Early immediate reduction or institution of reduction has done much to simplify the efforts required to obtain a return of normal function following fracture. That even prompt and proper first aid traction is an important factor in rapid recovery and avoidance of disability Kennedy has convincingly demonstrated. Reduction not only must be immediate but sufficiently accurate, and this *final accurate* position should be obtained at the first reduction or, when traction is used, in the first 24 hours. When late reduction is forced upon the patient or surgeon, the specter of disability looms low over his head, ready for imminent descent.

Extensive soft tissue injury, laceration of muscles, large blood vessels and especially of nerves will prolong the convalescent and disability period. Lesions of nerves at the time of fracture are added "weight for age" that are sure to delay the finish down the home stretch. These may be considered the only starting handicaps other than infection and certain types of fractures that can prevent *theoretically* the running of a true and swift course to the wire of complete recovery. However, *practically* every fracture, simple or complicated, may present its particular problem. The means at our disposal to meet that problem should be employed sufficiently flexibly. No definite routine should be fitted upon every fracture.

What may be considered the *sine qua non* of after-treatment may be summed up as follows:

1. Constant supervision of the immobilization apparatus.
2. Early physical therapy.
3. Active co-operation of the patient in efforts to regain function.
4. Occupational therapy. Early return to work.
5. Late protection of the site of fracture—walking caliper, brace, etc.

1. *Supervision of immobilization apparatus.* As experience in the treatment of fractures widens, more and more certain becomes the conviction that, no matter what the method of immobilization may be, constant supervision is imperative. Traction methods are well recognized potential trouble breeders, but casts and molded plaster splints cannot be ignored. The motion within or loosening of a cast and the slipping or loosening of splints may permit angulations or change in position of the fracture fragments that may lead to increased disability. Daily observations to prevent pressure areas should be the rule with frequent radiographic check-up on the original reduction, lest the unsuspecting surgeon be faced with a fracture deformity or displacement when its correction may be difficult.

2. *Early physical therapy.* Traction methods of treating fractures and molded plaster splints have been particularly favored because with them physical therapy may be begun almost immediately. Modern treatment is based on the recognition that the solution of the fracture problem consists of two almost equally important parts:

(a) adequate reduction and reunion of the fragments; (b) return of function.

Satisfactory reduction of a fracture, alone, does not guarantee normal recovery, and efforts to regain function must not be reserved simply for those fractures that present difficulties after the period of immobilization has passed, but must be used early and routinely in all fractures with but few exceptions. These efforts must be directed toward regaining function in muscles and joints. To regain function, or retain function, some motion, however slight, must be possible. In fractures, particularly about joints, immobilization for reduction may prevent motion. Personally, I am rather cautious in the removal of retention apparatus to obtain motion in joint fractures, but very often slight motion in the joint can be obtained without removal of restraint, especially with traction reduction or by merely partial removal of support—half of a cast or one of two molded splints. Motion may be obtained either by active efforts of the patient or by passive means. Action of the patient himself far outweighs in importance and efficacy any movement obtained by an external agency. Passive motion, except to guide the voluntary effort of the injured should be relegated to the exceptional case that in the last stages of treatment still presents some deficiency in function. The major problem of after-care, then, to prevent disability after the fracture itself has been satisfactorily dealt with, will be the problem of obtaining *active* motion in muscles and joints.

Immediately following a fracture there is contusion and laceration of the adjacent soft tissues and often muscle spasm, which causes pain and prevents active motion. It is *then* (early, not late), that physical therapy can be of greatest use. Very light stroking massage should be given to the traumatized *soft parts* as soon as possible after reduction, together with slow stimulation of the muscles by the faradic current such as is obtained by the Bristow coil or a myoneurostat. Daily treatments should be continued until *complete active* function returns.

The great value to be emphasized is that these measures merely *assist* and *aid* early *active* motion by the injured himself.

3. *Active co-operation of the patient.* The primary consideration is the injured man, his psychological reaction to his injury and treatment, and the extraordinary need for his participation in said treatment. To my mind this is *the most important element* in a satisfactory and normal recovery. There is so often a tendency for him to assume the attitude that it is the surgeon's job to get him well, that he is a prima donna in tableaux, i.e., without a speaking or acting part. The plan of treatment, therefore, should be outlined to the more intelligent patient in order to obtain his co-operation so far as possible, and the importance of his co-operation is stressed. Those with a *fear* complex or anxiety psychosis, particularly, need sympathetic and understanding supervision and direction to obtain satisfactory progress as, when this complex is established, it is exceedingly difficult to overcome. "The medical man must try to discover and constantly to recognize the exact mental attitude of the patient. This includes resentment at the injury, apathy, desire for compensation, fear of pain, keenness to get well, etc." (Hertzlet). His confidence must be gained in the methods and apparatus employed; he must be convinced that rapid recovery of function depends on him, and that physical therapy and massage are but adjuncts to help him help himself.

Early active motion must be inaugurated as soon as possible and encouraged in every way. Though traction-suspension methods are preferable, even the systematic exercise of fingers and toes with extremities in casts will be of infinite benefit. Permitting a patient to wear a cast until the full time for union has elapsed and making no effort to move the injured part is pernicious. Daily instruction in and test of muscle use should be practiced. Early indications of the return of function and of favorable developments must be pointed out, and if deformity—excess callus, etc.—occur it is important to emphasize that deformity does not necessarily mean disability.

4. *Occupational therapy.* After function has been somewhat restored, occupational therapy plays an important rôle. Hinton has shown rather strikingly that occupational therapy which takes full advantage of active motion is far more effective than massage and passive motion. Boehler advocates no passive motion but early ambulancy, use, and active motion. Murray favors "the increasing use of exceedingly varied and adaptable occupational therapy as the essentially logical after-treatment for the regaining of function, with physical therapy as an adjuvant." In studying the metabolism of massage, Cuthbertson points out that massage accelerates anabolic processes and causes diminished elimination or a retention of nitrogen, sulphur, and phosphorus in the tissues, probably in muscle and bone, as a result of their direct stimulation, but *active motion* produces even a greater retention. Theoretically, therefore, as well as practically, active voluntary effort of the injured is demonstrated to be the

greatest beneficial factor in regaining muscle strength and function.

Early return to work has much to recommend it, particularly if a "doubting Thomas" can be put on a job or back at his old job in the same environment in which he worked before; his mind is not only concentrated on work to be done, but he begins to use the disabled member by normal or natural movement incident to work and thus obtains a quicker recovery of complete function than by simple detached physical therapy. In other words, a real occupational therapy is substituted for an unfamiliar occupational therapy. If work can be done, or if a man is employed and draws pay, no discussion of disability or suggestion that the lesion may end in any degree of disability is raised. Attention is no longer centered on the accident and its consequences but on the need to speed up treatment and to co-operate until full function has been regained. Many of the neuroses of injury and prolongation of disability may be thus avoided.

Certain injuries, however, do not lend themselves to rapid return to work, notably: (a) head trauma, (b) extensive thoracic lesions, (c) fractures of the foot in which weight-bearing parts are involved. In certain states, also, injured coming under the Workmen's Compensation Laws cannot be put at work until they are cured or their case settled. Early return to work, therefore, cannot be considered a blanket formula but must be judiciously and individually employed.

5. *Late protection of the site of fracture.* Certain types of fracture unite slowly, or callus formation may be slow or insecure. As these are notably in the lower extremity, either at the neck of the femur or in the lower third of the tibia, to be ambulant and to avoid prolonged disability, some protecting or supporting device will be necessary. Occasionally, molded plaster splints are sufficient but more often some form of brace or walking caliper will have to be used. This need not delay return of function, as in selected cases return to work can be permitted before firm union is obtained. One of our cases, a fracture of the tibia, was back at his job for 2 years before union was considered sufficiently strong to permit discarding a brace. All such, however, must remain under supervision so that late bending deformity or angulation does not occur even at work. Physical therapy can be continued if it is felt advisable. It must be remembered that the responsibility of the surgeon not only holds for satisfactory and adequate primary treatment but continues until the injured person has a maximum return of function and a healed fracture, even though he may be back at work.

CONCLUSION

After-care of a fracture to avoid disability must include:

1. Constant supervision of the immobilization apparatus.

2. Late protection of the site of fracture when necessary to avoid deformity.

3. Early physical therapy. Physical therapy's most important position is early, not late, in treatment. Light stroking, massage, and faradic current stimulation are most essential.

4. Active co-operation and active motion on the part of the patient plays the chief rôle in obtaining normal return of function and avoiding disability. It must be supervised and encouraged constantly. It will be aided by occupational therapy and by early return to work.

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CLINICAL EXAMINATION VERSUS X-RAY EXAMINATION ESPECIALLY IN CHILDREN

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THE average fracture case does not have an adequate clinical examination. If this is not accepted as a truth, then what I have to say will be of no value. I do not believe that the records of clinics and private offices can contradict my premise.

What is the ordinary procedure when a patient presents himself at an emergency dressing station? The patient is not always carefully examined but an X-ray picture is peremptorily made. The report of the radiologist is often accepted as final. This is bound to lead to many errors.

The clinician of the pre-roentgen day was a thorough anatomist. His interpretation of the history and the subjective and objective phenomena enabled him to make a decision, whose accuracy would baffle and amaze many of our time.

My friend, Professor Matas, in a foreword to the volume on *Normal Bones and Joints*, said, "It is certain that the benefits that have accrued from the very simplicity and rapidity of the roentgenological diagnosis of these injuries are not unmixed blessings. Here, as in other regions of the body which have been made translucent by roentgen rays, the tendency of the practitioner is to accept the verdict of the roentgen laboratory unconditionally, with little or no effort to correlate the findings of the laboratory with the clinical evidence, and not to question the possible fallacy of the roentgenological interpretation. In this way, the time honored Hippocratic habit of observation and the cultivation of the clinical sense, which are the fruits of personal observation and prolonged contact with the sick, are rapidly becoming lost arts. In this way, again, the substitution of diagnostic interpretations based upon fluoroscopic images and roentgenologic films, for the rational and methodical investigations of the patient's signs and symptoms, tends to dwarf the analytical and critical qualities of mind and to blunt the keen perceptions so necessary to a correct surgical judgment."

I would not decry the value of the X-ray, but I would rather remind you that the value of any picture is dependent on the interpretation. Further, no diagnosis should be made entirely on a single finding. A fracture is, after all, more than a broken bone. It is essential to make all mechanical diagnostic aids handmaids of the brain and not the reverse.

The value of the X-ray, I repeat, is dependent on the interpretation. In children the interpretation is difficult. During the period prior to ossification of the epiphyses it is impossible for the X-ray picture to disclose a fracture as cartilage does not cast a definite shadow. During the period of childhood ignorance of the appearance of the normal joint leads many to diagnose from the picture an epiphyseal separation when in reality no such condition exists.

These last two facts are responsible for the persistence in the literature of two rather questionable diagnoses—*sprains and epiphyseal separations*. These diagnoses would not be ventured so often if careful clinical examinations were made in every case.

When the diagnosis sprain or contusion is applied to an injury which results from trauma, it is presumptive; by that I mean that much is taken for granted. The surgeon assumes that only soft tissue damage has occurred. Often this assumption is made without due investigation by those scientific measures which are at our command. Such carelessness cannot be justified. This is well illustrated in a damage suit quoted by Scudder in the last edition of his work on fractures, Nickerson vs. Gerrish. The court awarded $5,000.00 damage in favor of the plaintiff. The basis of the decision was that "the mistake was the result of a failure of the defendant to use painstaking care and diligence and to exercise the best of his admitted learning, skill, and judgment in his examination and treatment of the plaintiff's injuries."

It is interesting to note the frequency with which the terms are applied to what seemed originally to be simple injuries, some of which in the course of time become serious and demand active intervention. Modern textbooks barely mention the terms. Medical journals for the past few years contain few references to them; in fact, one would think that surgeons did not see so called sprains from the infrequency of reference to them in the literature.

How is it, then, that so many surgeons and general practitioners are willing to assume that an indefinable and hypothetical condition really exists so frequently? They seem to overlook the fact that these patients, when unrelieved, find their way to someone who is willing to make a

careful investigation in order to determine just what has happened.

The modern attitude toward sprains may be said to have had its birth in Philadelphia. The pioneer work of Ross and Stewart has been of inestimable value. Their announcement in 1912, "the word sprain standing alone we eliminate," fell like a bomb on the camp of the indifferent who had complacently treated so many for this hypothetical injury.

Unfortunately, it seems that surgeons feel like apologizing for discussing the subject of sprains. One need not apologize for speaking about a term which might almost be eliminated has not custom dignified its use.

The term "sprain" conveys the impression that the ligaments have been lacerated. Ross and Stewart have provided experimental proof that the ligaments have greater tensile strength than the bony prominences to which they are attached. When a joint is forced to describe a greater arc than its normal range of motion we may expect a fracture rather than soft tissue damage alone.

In regard to fractures of the greater tuberosity of the humerus this fact has been appreciated for a long while, and to such an extent that some authorities denied the existence of this injury independent of a dislocation of the shoulder. A diagnosis of sprain is not justifiable unless one can convince himself by every possible means that a fracture does not exist.

The conception of a ligamentous tear is purely hypothetical. No one dies of sprains and operations are not done for their relief; therefore the pathology is not known. On the other hand, if careful examinations are made the existence of a fracture can be determined in most instances. If the diagnosis of sprain is made the patient often later seeks treatment and fractures are found.

It is equally true that the diagnosis of fracture will often be made by those who do not appreciate the normal appearance of the developing epiphysis. A knowledge of this subject is essential to the management of injuries about the joints in children.

These statements are easily proved by clinical evidence.

Epiphyseal separation is a term which might well be discarded and replaced by the expression epiphyseal fracture. The epiphysis to be separated from the diaphysis must move independently. To do this there must be a solution of continuity in cartilage which makes all "separations" fractures, according to our present definition. Many so called epiphyseal separations are in reality normal joints.

The importance of the subject of the normal joint cannot be overestimated. Errors in interpretation of X-ray pictures will constantly creep in if we do not recognize the appearance of the joints at various ages and the relationship of the epiphysis to the diaphysis.

It is because of the inherent fallacy of depending on a single method, the accuracy of which is largely dependent on a personal factor, that it becomes our duty to rely largely on the clinical examination. In every other field we are constantly reminded of the value of the history and physical examination. Why should we relegate these valuable procedures to a minor part? Emphasis should be laid on the fact that they should be major and not minor in our diagnostic scheme. The clinical history and examination requires little time, but the time so spent may avoid many unpleasant sequelæ. From the history of the accident we rapidly obtain the information as to the loss of function and pain. Loss of function, if properly interpreted, helps to localize the site of the injury in the surgeon's mind. Normal function is dependent on the harmonious interaction of groups of muscles. When, as a result of injury, the opposing groups of muscles no longer act on the bone as a whole, one group acting on one fragment and one on the other, a deformity results, and one or another of the normal functions is lost.

It is true that interpretation requires constant visualization of anatomy. This should not be considered an undue hardship. Certainly this knowledge of anatomy is essential for operative procedures, why then should it not be utilized for diagnosis?

The examination of an injured part should be done in a systematic manner. While this may sound academic, it is nevertheless true that it is one of the neglected academic truths. We might further state that at the present time it is even a neglected academic matter. It is surprising how little time is devoted to this important subject in our under-graduate curriculum. This is no less true of the post-graduate courses. In a survey made by the Committee on Fractures of the College this latter fact was clearly demonstrated.

Each part of the clinical examination reveals data which when combined makes the diagnosis fairly accurate. The X-ray film then becomes confirmatory evidence rather than the paramount factor.

Inspection by a trained eye immediately indicates the attitude, a change in the axis of the limb if it exists, shortening, and angulation. It also indicates other important findings, such as

swelling, ecchymosis, and whether or not there is a compound fracture. Palpation, which should always be gentle, reveals the most important single manifestation, localized pain.

Where no gross deformity exists localized pain is the most dependable clinical evidence of fracture when it is associated with partial loss of function.

I think that we should emphasize that crepitus should not be sought for, certainly not while the patient is conscious. To obtain crepitus manipulations which are painful are necessary, moreover such manipulations are bound to increase the soft tissue damage. All readily admit that additional trauma should be avoided.

Mensuration as a part of the examination is almost a lost art.

We would do a much better job if we would devote more attention to such fundamentals and less to teaching so many new and complicated mechanical devices for treating fractures.

Examination under an anæsthetic is of greater value in children, where the history and clinical examination are suggestive, than the X-ray.

End-results in fractures would be better if more time were devoted to clinical diagnosis.

FRACTURE DISABILITIES OF THE WRIST

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THERE are five major factors responsible for chronic disability following fracture of the wrist: (1) disalinement in so far as it impairs range and direction of joint motion; (2) degenerative arthritis which follows fractures penetrating into the joint; (3) progressive contractures associated with injuries of muscle and tendon sheaths and to the capsular apparatus; (4) secondary involvement of the median and ulnar nerves; (5) reflex atrophy of the wrist and forearm bones on circulatory basis (Sudeck's atrophy).

I. FRACTURES OF THE RADIUS AND ULNA

1. *Disability due to disalinement.* The effect upon the wrist is purely mechanical. The most frequent deformity in Colles' fracture is the silver fork deformity resulting from failure to apply or maintain sufficient traction at reduction, two mechanical difficulties being thus produced. The rotation of the lower fragment in the sagittal plane causes the joint surface to look distally and dorsally instead of distally and volarly. The immediate effect is limitation of flexion. The impaction of the lower fragment into the radial shaft produces a radial deviation of the wrist, which, while leaving radial abduction intact, greatly interferes with ulnar abduction. The dynamic effect of this disalinement is two-fold: First, it restricts flexion of the fingers and interferes with the efficiency of the grip; and second, it changes the plane of the flexion or extension field, which is normally in an oblique plane from dorsal and radial to volar and ulnar, to the direction of dorso-ulnar to volar and radial. Many patients, who otherwise have a sufficient range of motion, complain that the wrist now moves in the "wrong direction." This deflection assumes an exaggerated form in cases of epiphyseal separation in which destruction of the epiphysis accentuates the deformity.

Pseudarthroses are less frequent in Colles' fracture. Seven cases were observed in this series.

The reversed silver fork deformity is produced by hyperflexion or crank fractures. Disability here primarily limits extension and is often associated with adaptive shortening of the flexor muscles.

Inhibition of the rotatory motion by impingement of the forward displaced ulna frequently occurs, due to the forward displacement of the ulnar portion in the lower radio-ulnar articulation. In these cases supinatory range suffers most.

Reconstruction of the orbicular ligament by fascia is the method of choice. In several cases in which there was an irreducible forward dislocation of the ulnar head interfering with pronation and supination, we ankylosed the lower end of the ulna to the radius and then resected about one-half inch from the shaft above the capitulum, thereby forming a new joint through which pronatory and supinatory motion took place. This method was originally advised by Messer and Lauenstein.

The silver fork disalinement inhibits mostly flexion and must be treated by open reduction and osteotomy. In cases of atrophy insertion of a bone graft can be recommended. Belated union after correction by osteotomy is best treated by the Beck's drill method. In all cases of true

pseudoarthrosis refreshening and graft are necessary.

2. *Traumatic arthritis complicating fracture deformity.* Traumatic arthritis is either secondary due to circulatory changes and immobilization or it develops directly at the site of fracture when the latter enters the joint. Disability is great in spite of good alinement. Almost invariably there exists a constitutional cause—advanced age, arteriosclerosis, etc. Traumatic arthritis is usually situated in the radiocarpal articulation in which event the lower radio-ulnar joint is also involved, which means limitation of pronatory and supinatory movement. In one instance we have seen arthritis limited to the articulation between the semilunar and the os magnum, motion being restricted by pain and swelling, although alinement of the fragments was good except for slight radial deviation.

As a rule the outlook for secondary traumatic arthritis is not unfavorable except in old cases. Physical therapy and proper splinting usually accomplish the desired improvement.

3. *Secondary contractures complicating fracture deformity.* Muscle contractures are not the immediate result of mechanical disalinement, but are due to damage to tendon sheath and injuries to the tendinous apparatus. For instance, in some comparatively young individuals in fracture with silver fork deformity and radial deviation, radial clubhand deformity was observed in such degree that an involvement of the tendon sheath, probably intravaginal hæmorrhage leading to tendon sheath adhesions, had to be assumed. Correction of the deformity by osteotomy must be followed by conservative corrective measures for the release of the contracture.

In general, the outlook of these contractures is good, provided the skeletal disalinement is rectified, and it requires rarely operative interference on the tendons. Complicating traumatic arthritis considerably lessens the prospect.

4. *Peripheral nerve involvement complicating fracture deformity.* All three nerves have been found involved. The most frequent types are ulnar and median nerve palsy with thenar or hypothenar atrophy, sensory disturbances, and trophic changes. It is often remarkable how the trophic disturbances will change when the deformity is corrected, particularly if the injuries have resulted in secondary contractures, such as flexion of the wrist or hyperextension of the metacarpophalangeal joints. Combined ulnar and median involvements are comparatively frequent. Ulnar palsy is not infrequent in cases of ulnar displacement of the capitulum. The sensory disturbances may range from slight formication to complete sensory and motor interruption with hypothenar atrophy and atrophy of the interossei.

5. *Fracture deformities complicated with reflex atrophy (Sudeck's atrophy).* The nature of this type of atrophy is still in doubt, but it is believed to be based upon circulatory influence. It has nothing to do with direct degenerative traumatic arthritis. There is a preservation of the joint contours and joint cartilage. The atrophy is in the interior of the cancellous bone and many osteoclasts are found. This type of atrophy leads to very severe functional impairment of the wrist in spite of good alinement, swelling and œdema of the soft parts, pain and immobility. Little may be expected from protracted conservative treatment and physical therapy, and the outlook is doubtful. Severe constitutional sources are usually in the background.

II. TRAUMATIC DISABILITIES FROM INJURIES TO THE CARPAL BONES

1. *Fracture of the scaphoid. Disalinement.* The following comments pertain to a series of 22 inveterate cases of fracture of the carpal scaphoid, all ununited. Until recently it was the general opinion that fractures of the scaphoid seldom healed. Hirsch pointed out that the question of healing of the fracture depends upon the site and the accompanying injury to the ligamentous apparatus. Extra-articular fractures always heal because there is no disalinement. In intra-articular transverse fractures it depends upon the site. If the central nutrient artery is destroyed necrosis of the proximal segment and pseudarthrosis follow. Newer observations of Boehler, Schnek, and others show that with proper technique of immobilization healing of fracture of a carpal scaphoid is the rule rather than the exception, an opinion in which Mouchet and Delchef concur on the strength of their own experience. Schnek claims 100 per cent cure by primary immobilization, pointing out that it is necessary that during fixation the fingers remain movable and that the thumb be included.

These disabilities are due to disalinement or failure in union. The methods applied were total removal of the scaphoid, partial removal, bone graft and drill methods, and conservative methods. The conservative methods were not satisfactory on the whole in cases with longer than 2 months' duration. Removal of both fragments was as a rule more satisfactory than partial removal, although in neither case complete range of motion or complete function of the grip could be obtained. Bone graft was employed in one case,

drill method in two cases with satisfactory results.

2. *Traumatic disabilities due to complications of Colles' fracture with carpal injuries* are seen frequently in intra-articular fractures of the radius, associated fracture deformities of the scaphoid, together with anterior displacement of the ulna and disalinement of the fragments. In such instances both flexion and extension is strongly limited as well as abduction and adduction, the disability combining that of the fractured scaphoid with mal-united Colles'. Nevertheless, in some instances, almost complete return of motion was observed after prolonged physical therapy. In another instance of re-fractured Colles' with silver fork deformity there was a complication with dislocation of the semilunar, crush fracture of the radius and fracture of the triquetrum. In addition there was involvement of both the ulnar and median nerves. This case called for correction by osteotomy and for removal of the fractured scaphoid and the dislocated semilunar bone. The result was satisfactory.

3. *Traumatic malacia of the lunatum following disabilities due to wrist injuries.* The traumatic background of this rather rare condition is likewise the group of fracture disabilities. The disease, usually occurring in males, caused often by single trauma, is believed to be due to the impact of the radius upon the lunatum. In inveterate cases we found swelling, increase of the dorsoventral diameter, and restriction of motion in all directions. It is characteristic for this type that upon closing of the fist there is a recession of the third metacarpal and a shortening of this bone of one and one-half centimeters. This is due to the flattening of the semilunar bone. Both of our cases have required the removal of the semilunar bone by operation and were attended by satisfactory results. This condition, called Kienboeck's disease or traumatic osteomalacia of the semilunar bone, is hard to differentiate from the pseudotraumatic cyst often seen as occupational disease and beginning with evidences of absorption of the center of the bone.

SUMMARY

This short analysis dealing with fracture disabilities at the lower end of the radius and the wrist, extra-articular or intra-articular fractures of the scaphoid, secondary traumatic malacias and atrophies, covers only a small portion of all traumatic deformities of this region. It is shown that the disalinement itself is the least disabling element. Of much more weight in determining the ultimate degree of disability are the effects of disalinement upon the joint mechanics, the involvement of the joint itself in the fracture, the secondary reaction of the joint to the injury by degenerative arthritis, circulatory reaction in form of reflex atrophy of the Sudeck type, the involvement of the nerves leading to severe motor and sensory disturbances in their territory, and finally the secondary tendinous contractures due to injuries of the tendon sheaths or the tendons themselves.

CONFERENCE ON TRAUMATIC SURGERY

INDUSTRIAL MEDICINE AND TRAUMATIC SURGERY

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WE meet again this year to discuss some of the phases of the scientific aspect of industrial medicine and traumatic surgery and to report upon the results of our comprehensive survey of industrial clinics. Further, we desire to visualize the future so that we may anticipate the potentialities of our future activities.

One need not emphasize the importance of medicine and surgery in industry to a group of understanding surgeons, for in our present rapidly changing industrial situation it is becoming more and more apparent how essential it is to keep the vast army of workers healthy and fit.

It has been said repeatedly that the work of the Board on Industrial Medicine and Traumatic Surgery is educational, and this is true. Following this thought through we must attempt to analyze the attitude of the leaders of industry whom we hope to educate.

There is a vast amount of convincing and compelling evidence that a large number of employers have little conception of what it is all about. They fail to grasp what an immense financial saving it would be to them to improve the health welfare of their employees. There is no conflict of interest. How conspicuously consistent is the fundamental principle that healthy men and women are more efficient than the unfit. The financial saving, if this principle is carried out, is self evident.

How can this fact be presented so that industrialists will understand? One illustration may suffice to state the existing condition clearly and to suggest an argument that may be used.

A recent survey was made of 550 tannery employees, and careful physical examinations made and recorded. Twenty-five of these workers had hernias that were not protected by trusses. How much did this lack of protection interfere with the value of the service they were attempting to render? It cannot be measured accurately, but it is enormous if computed in dollars and cents. Twenty-five per cent of the 550 examined had errors of vision, most of which were correctable. Many of these workers with defective eyesight were employed in using machines that require the feeding of leather between scrapers and rollers and other mechanical devices.

It is not necessary to present statistics of the large number of lost fingers and arms in this one plant during the past few years, or the reason why such loss has occurred. Think of the financial saving that would have accrued to this one company if these accidents could have been prevented, and who doubts that the correction of vision in one in five of these workers would have saved many fingers and much economic loss to both employer and employee?

Organized medicine has no thought of attempting to dictate to the captains of industry how they shall manage their business, but we do insist that we are better equipped to chart the seas of medicine and surgery in industry than they are.

What can be more logical than to assume that competent physicians and surgeons should be allowed to chart these seas and indicate the location of the reefs of silicosis, and the rocks of infection, and the dangerous shoals of fractures, so that the captains of the ships of industry following such charts may steer a course that will not endanger their craft? There must be more cooperation and correlation of effort if the present deplorable condition arising out of accidents is to be corrected.

How truly this all applies to the majority—not all—of compensation insurance companies who entrust all policies concerning accidents to the claim department, the head of which considers the medical department a poor but perhaps necessary subsidiary. In connection with the compensation insurance companies it is noted that recently they have been advancing the policy of securing the cheapest medical and surgical service possible. In Illinois they have adopted a fee schedule of $2.00 for first aid and $1.00 for subsequent dressings—all of this in the face of the fact that the cost of the materials used by the surgeon and all of his other expenses are mounting higher and higher. If these companies are taking

advantage of the unfortunate financial status of the medical profession in the present situation and are attempting to exploit it, we venture to predict that they are making a grievous error in judgment and policy. Such a program may act as a boomerang.

In any attempt to anticipate future industrial conditions one must evaluate the influence of the National Industrial Recovery Act in the principle of which we all believe firmly. Every right minded, clear thinking citizen is willing to support this courageous and intelligent plan for recovery, and it is bound to succeed. Obviously, there should be an opportunity for organized medicine to influence the character of medical and surgical service that the National Recovery Administration should request or require industrialists to accept. Dr. Franklin H. Martin, our Director General, with his clear, far-sighted vision has anticipated this situation, and has contacted the authorities in Washington. Of this contact and of his future plans he will tell us.

WILL INDUSTRIAL MEDICINE AND TRAUMATIC SURGERY HAVE A PLACE IN THE NATIONAL INDUSTRIAL RECOVERY ACT?

FRANKLIN H. MARTIN, M.D., F.A.C.S., CHICAGO

THE Board on Industrial Medicine and Traumatic Surgery had its genesis during the Great War. Traditions and theories were ruthlessly cast aside. It was necessary to execute tasks expeditiously and efficiently, and with the greatest economy of management, money, and man power. It was advantageous to the government to develop every facility that would preserve health. Hence a committee on industrial medicine was organized by the Medical Section of the Council of National Defense. Thus government planning and control demonstrated the economic and life-conserving value of a co-operative program such as the American College of Surgeons is endeavoring to put into effect as a voluntary measure.

In a word, this program demonstrated as never before that the employer and the employee could accomplish most if they worked together harmoniously. The great leaders of industry, of labor, and of insurance composed their differences, to the great benefit of all concerned. This war experience was a progenitor of the Board under whose auspices this conference is being held.

In 1922 Dr. Daniel Z. Dunott convinced the Association of Railway Executives that railway employees would receive the most efficient care in hospitals approved by the American College of Surgeons. Forthwith, by proclamation to the railroads, this association suggested that the employees of railroads, so far as it was possible and practicable, should be treated in approved hospitals.

At the organization meeting of the Board on Industrial Medicine and Traumatic Surgery held during the Montreal Clinical Congress in 1926, an important first principle was recognized. The leaders of industry, of labor, of the insurance and indemnity companies, and of compensation commissions must harmonize their interests. And it is an outstanding slogan of the College that if we can convince the heads of these groups we will be insured of the full, unqualified co-operation of assistants and associates.

The chairman of our Board, Dr. Frederic A. Besley, accompanied me to Washington on June 13, 1933, and we presented in detail the findings and accomplishments of the Board on Industrial Medicine and Traumatic Surgery to the head of the National Recovery Administration, General Hugh S. Johnson, and left with him an outline of a suggested code. His deputy administrator, W. L. Allen, in charge of the hearings of the National Recovery Administration, read our suggestions, accepted them as a basis for consideration, immediately dictated a suggested code covering our representations, and placed the two documents on file in his office for future reference.

We have every reason to believe, from our very sympathetic contact, that, when the time comes, undoubtedly our suggestions for the medical and surgical care of men and women in industry will aid in forming the basis of any related plans that may be formulated under the National Industrial Recovery Act.

A THREE YEARS' SURVEY OF MEDICINE AND SURGERY IN INDUSTRY: INCLUDING LEGISLATIVE ENACTMENTS AND OTHER INDEMNITY PROBLEMS

M. N. NEWQUIST, M.D., CHICAGO

So closely related are the compensation laws and their administration to the economics, scope, and extent of medical and surgical service in industry, that a proper appreciation of this relationship necessitates first a brief review of the legislative enactments involving medical service.

The first modern workmen's compensation law to displace the obsolete master and servant doctrines and the liability rule was enacted by Germany under Bismarck in 1884. The United States was one of the last countries to adopt the new compensation principle, which holds that loss of time or bodily injury to an employee as a result of an industrial injury should be charged to the consumer as an incidental cost of production similar to the charge made for wear and breakages of machinery and used raw material. From 1911 to 1929 forty-four states and the District of Columbia enacted compensation laws. The federal government has provided similarly for civil employees, longshoremen, and harbor workers. The medical profession as an organized body had very little or nothing to do with the framing of the original acts. Arkansas, Mississippi, South Carolina, and Florida have no compensation laws.

The inadequacy of medical and compensation benefits is recognized quite generally, yet the rank and file of injured employees subject to the acts receive greater and more prompt medical and financial benefits as a whole than do those who are subject to the liability laws. The United States Bureau of Labor Statistics has estimated that the injured employee bears 50 to 85 per cent of the burden involved depending upon the state in which he is injured. Lack of uniformity in the various state laws, plus varying interpretations and administrations, have thus created the situation where employees similarly injured are compensated differently. The trend of recent legislation, however, is to liberalize the laws in favor of the worker and a noticeable effort is being made to approach a common end.

Insurance systems. Payments of compensation and medical benefits are secured through stock or mutual insurance companies, through state fund insurance systems, or through self insurance. There are seventeen general state fund insurance systems of which seven are monopolistic while ten compete with other insurance. The bulk of the compensation insurance is carried at present by stock companies but since the average expense ratio of stock companies is about 40 per cent, of mutual companies about 20 per cent, of competitive state funds about 10 per cent, and of exclusive state funds about 4 per cent, the present sentiment is toward state fund insurance.

Medical and surgical aid under compensation. All states having compensation laws provide medical and surgical benefits. Most acts state that the employer or insurer must furnish reasonable medical, surgical, and hospital service. The employer can shift this responsibility over to the insurance carrier, which is a common practice. This eliminates free choice of doctor and hospital by the individual injured.

In only two states, Massachusetts and Rhode Island, is provision made by direct expression in the statutes for a free choice of doctor by the individual injured. Seven states either extend a limited choice of doctor or simply fix the responsibility for the costs of medical service upon the employer or the insurer. Provision is generally made for free choice of doctor and hospital by an employee, at the employer's expense, in case the employer fails to provide such services. Some states allow freedom of choice in emergencies, but as a whole any service other than that provided by the employer or the insurer, would be at the employee's own expense. Compensation is stopped as a rule if an injured employee refuses to accept reasonable medical and surgical treatment. Four states recognize non-medical service in the treatment of compensable injuries.

In the selection of a physician the confidential relationship between the patient and physician is forgotten by the employers and insurance carriers and their choice is based upon economics and end-results. As an illustration of their reason for choosing the physician, the report from the Accident Commission of California in 1918 shows that in 26,851 cases treated by the company doctor and 69,494 cases by private treatment, the company doctor had 25 per cent less disability in 1914 and 19.6 per cent less disability in 1917 than the private doctor who was paid on a fee basis. Another continuing study is now being made by a

large insurance company of the costs and disabilities of injuries based upon the physician being selected or unselected by the insurance carrier but all on a fee basis. In the first 4,880 cases including all types it was found that the group treated by unselected physicians showed a 64 per cent higher average compensation cost and 39 per cent greater disability than the group treated by selected physicians. This difference cannot all be attributed to actual disability. The private physician, in the alleged prolongation of treatment, probably errs on the side of safety, while the company doctor may return some of the patients to work even before health is restored. These two factors, however, would account for only a small percentage of the difference. In the final analysis it resolves itself into a question of organization to provide prompt medical service and a question of competency in traumatic surgery.

Organization should not be considered as a cure-all but without it the desired objectives will not be accomplished. The responsibility of the industrially injured belongs also to organized medicine. It is the responsibility of organized medicine to make available to the injured in industry surgery of the finest type. If the interest of the injured worker is placed foremost this then automatically limits choice of physicians to those who are competent in industrial medicine and traumatic surgery. Unless the medical profession is willing to act along these lines, industry and the insurance carriers will persist in using their selected panels of physicians.

The New York State Medical Society has taken an important step in the right direction by reaching a "gentleman's agreement" and by providing for joint arbitration with insurance carriers of all disputed medical claims. It is hoped that their program will go farther than the question of fees and case lifting. Nevertheless the functioning of this arbitration board has already had a beneficial effect in improving the quality of medical and surgical services in order to avoid the need for arbitration.

Occupational diseases. Occupational diseases are recognized by twelve states, by the District of Columbia, and by the United States Acts for civil employees, longshoremen, and harbor workers. Such diseases generally are compensated in foreign countries. Six states provide coverage by general reference, while the other six have a schedule of diseases ranging from one to twenty-seven. The frequency or percentage of occupational disease claims to total compensation claims ranges from 0.3 per cent in New York to 2.9 per cent in Ohio. Occupational disease claims average 59 per cent greater disability than do claims for accidental injury. The Ohio Industrial Commission reported the cost of occupational disease in 1929 as 0.9 per cent, and in 1931 as 1.2 per cent of the total cost.

With over $125,000,000 worth of damage suits in the United States at the present time for silicosis alone, it is expected that the economic and social pressure will force the recognition of occupational diseases by all compensation laws. In fact since January 1, 1933, all compensation insurance rates for the United States have been raised 1 per cent for occupational disease coverage in general and an additional charge made where specific hazards exist.

Utilization of physicians in compensation administration. Only one-third of the state compensation commissions have medical departments. In the administration of all the compensation acts a layman renders the final decision as to the amount of disability which is based entirely upon medical, surgical, and physical aspects. This appropriation of medical prerogatives will continue as long as organized medicine does not assert itself. Certainly, in the administration of any law involving occupational diseases and injuries, the interpretation and estimation of disability should be vested in physicians who are adequately trained in those fields.

Each state should have a medical board appointed as an additional unit in the compensation system to assist in its operation. Without such a board there is grave danger of occupational disease compensation being converted into insurance for health, unemployment or old age. This has already been done in many instances, even to the point of absurdity. The duties of this board in regard to occupational disease should be:

1. To determine if the claimant was suffering from an occupational disease.
2. To determine which employment gave rise to the disease.
3. To determine the amount of disability or the cause of death.
4. To make recommendations as to future treatment and occupation.
5. To keep abreast of all old and new industrial processes in relation to occupational diseases and to make recommendations relative to preventive measures.

The findings and decisions of the board should be final as to medical evidence and facts.

The personnel of this board should be composed of physicians who are qualified in specialties which are applicable to this field. They should devote

full time if possible, the pay should be adequate, and the appointment should be permanent. To prevent the political abuse of such appointments they should be selected from a list recommended by the State Medical Society.

Costs of medical service in industry and of industrial accidents. The National Industrial Conference Board has reported that there was an average cost in 1930 of $5.10 per employee per year for medical services furnished by the employer that consisted of at least a full time graduate nurse and a well equipped dispensary.

On the basis of records and experience, in 1930 H. W. Heinrich, assistant superintendent of the Travelers Insurance Company, estimated that there are 25,000 fatalities, 3,000,000 loss of time injuries, 87,000,000 minor injuries, and 300,000,000 no injury accidents in industry annually. The United States Bureau of Labor Statistics states that $72,000,000 are paid annually for medical and hospital services and $240,000,000 per year for compensation. With the indirect costs estimated to be four times as great as the direct costs, the Bureau has estimated the total cost of industrial injuries to be over $5,000,000,000 annually.

In 1912 the medical costs were 5 per cent of the amount paid for compensation; today they are about 35 per cent of the amount. During the present economic stringency there has been an increase in both medical and compensation costs. The Ohio Industrial Commission reports that from 1929 to 1931 compensation costs increased 9.4 per cent and medical costs increased 20 per cent.

Needs in the field of industrial medicine and traumatic surgery. Surveys of medical services of industries during the past 3 years have revealed that the larger industries, and particularly those which are self insured, have handled the problem of caring for their injured employees in a satisfactory manner. However, the following needs have repeatedly manifested themselves so as to be worthy of enumeration:

1. The need for more uniform workmen's compensation laws.
2. The need for a federal compensation law for railway employees.
3. The need for recognition by the state compensation laws of occupational diseases on the same basis as accidental injuries.
4. The need for a medical department or board as an administrative unit in each state compensation commission.
5. The need for adequate medical service and supervision in the smaller industries.
6. The need for the placing of medical departments and service on an equal basis with other departments within the industrial organizations. The physician in charge to have final authority on all medical problems and to be responsible only to a major executive.
7. The need for industry and the physicians who are serving industry to convince labor that pre-employment and periodic physical examinations are a mutual benefit, and that the records thereof are not used, as termed by labor, as a "black list."
8. The need for organized medicine to make available better service in traumatic surgery, and to maintain a working knowledge of work requirements, industrial poisoning, and occupational diseases in general.
9. The need to promote better working relations between industry and insurance carriers and the medical profession.

Field of application and recent experiences involving medical service in industry. The population of the United States according to the 1930 census was 122,775,046 of which 48,829,920 over ten years of age were occupied gainfully. The term "gainful workers" does not include women working in their own homes or others not gainfully occupied. Of these gainful workers, approximately 22,000,000 receive medical service for industrial injuries under the compensation laws, the balance of those gainfully occupied may or may not receive medical service under the Employer Liability Laws. From 1920 to 1930 the population of the United States increased 16.1 per cent but the machine and mass production has reduced the number of factory workers 1.8 per cent.

Percentage distribution of wage earners among manufacturing establishments. In 1929 there were 14,110,652 employees in manufacturing and mechanical industries. Of the total number of industrial employees 75.5 per cent are in industries having less than 1,000 employees where full time industrial surgeons rarely are maintained. This clearly indicates the important part that the private practitioner must play in serving industry. Even in the larger industries the general surgeon cares for a large percentage of the serious injuries. Industry as a whole depends upon the private practitioner—but along with this dependence he is challenged by the fact that it is the group of industries of less than 100 employees, representing 30 per cent of the industrial workers, that lacks adequate medical service.

Sickness experience and costs in industry. Accidents are not the only source of loss which involve medical service. It is generally accepted that ill-

ness causes eight times more absenteeism than accidents. According to the National Industrial Conference Board, 30 per cent of the work of medical departments in industry in 1930 was made up of medical cases.

A study made by the United States Public Health Service from 1921 to 1927, of an average of 105,072 male industrial employees, showed the following relative frequency of diseases based upon an absenteeism of 7 days or more:

	Per cent
Respiratory diseases	41.8
Digestive diseases	13.7
External causes	10.0
Circulatory and genito-urinary diseases	6.7
Rheumatism	5.8
Diseases of nervous system	4.3
Diseases of the skin	3.8
Diseases of organs of locomotion	3.3
Epidemic and endemic diseases	2.7
All other causes	7.9

Two per cent of the workers are incapacitated all the time on account of illness. Benefit associations of railway employees have reported 3 per cent of the employees drawing sickness benefits at all times, and it is not uncommon to find a 4 per cent absenteeism in some industries. Dr. W. S. Rankin, of the United States Public Health Service, estimates that for every person so incapacitated there were at least two physically impaired to the extent of 10 to 50 per cent of their efficiency on account of prevalent and chronic diseases. In the United States this amounts to a loss of two billion dollars in decreased earning capacity and six billion dollars through postponable deaths, or a total of eight billion dollars a year.

Comparison of sickness frequency and severity rates in prosperity and depression years. A recent study, made by the United States Public Health Service for 1929 and 1932, showed the sickness frequency rate in industry to have declined 19 per cent, but that its severity rate had increased 4 per cent. It is felt that the increase in severity would have been approximately 10 per cent had not the total number of employees in the 21 establishments studied, dropped from 144,009 to 120,555, at which time the chronically ill were eliminated from the pay roll. Steel companies reported an increase in severity of from 54 to 92 per cent. Since these employees were all members of sick benefit funds this increase in severity is undoubtedly the conversion of the benefits into unemployment insurance. During the depression the compensation benefits for injuries have suffered somewhat from a similar tendency.

Industrial fatalities. As reported by the National Safety Council, industry had a total of 19,000 accidental deaths in 1930 of a total of 99,000 for the nation as a whole. Motor vehicles caused 33,000 fatalities in 1930 and 29,500 in 1932. In 1932 industry had 15,000 deaths out of a total of 88,000. If the same ratio of injuries per fatality holds throughout, due to the extension of the machine age, there is then approximately as much traumatic surgery per capita in private and public life as in industry.

Accident rates in industry. Based upon the reports from 1,562 establishments the National Safety Council states that with the exception of permanent partial disability in 1929 the frequency and severity rates for industry have decreased as a whole. From 1928 to 1930 the frequency decreased nearly 28 per cent and the severity dropped over 8 per cent.

The actual decrease in the number of accidents in individual industries is proportionate to the amount of effort put forth in prevention. Since 1913 a part of the steel industry, producing about 50 per cent of the total output, reduced its accident frequency rate 89 per cent through energetic safety measures, while the balance reduced their rate only 15 per cent.

There is a wide variation in accident rates in the different types of industry. Records of the National Safety Council reveal that lost time injuries are eight times as numerous in construction work as in cement manufacturing, while thirty times as many days are lost from injuries in mining operations as in printing and publishing. Their experience further shows that in spite of the great difference in hazards of the various industries, large companies have been more successful in reducing their accident frequency than small ones. Relative to hours worked there are over twice as many accidents in the small industry of 100 or less as there are in the larger industry having 1,000 employees or more. The severity rates have also declined with the increase in size of company, but not so markedly. The comparative high rate of severity in the industries having under 100 employees, outside of diversification of duties, is due principally to two factors; first, lack of adequate safety measures; second, lack of adequate medical care. The astounding fact is that industries of less than 100 employees have approximately 60 per cent more lost time from injuries than the general average.

This experience shows lack of prompt medical service for minor injuries due to faulty organization and supervision rather than lack of skill. Dr. Carey P. McCord, medical director of The

Industrial Health Conservancy Laboratories, states that adequate medical service through prevention of infection alone would reduce this lost time by one-third. The local county medical societies could well co-operate with the small industries in their communities and even take the initiative in promoting some plan to correct this situation.

PREVENTIVE HEALTH MEASURES IN INDUSTRY AS REVEALED IN A THREE YEARS' SURVEY

E. W. WILLIAMSON, M.D., CHICAGO

WITHIN recent years the number of injuries sustained by employees of industry has been definitely reduced by effective preventive measures such as safety and accident prevention campaigns, improved methods and machinery, modernized working environment, and care as to training and placement of the employee.

On account of the requirements of the labor laws of many states and the voluntary action of the employer, facilities for first treatment of the injured are so generally supplied in the factory and workshop that a large percentage of the 20,000,000 employees subject to the compensation laws in the United States now have a service available for immediate treatment of injuries. It is not uncommon to receive a report from an industry that its accident rate has been reduced 60 to 75 per cent. The safety organizations of many companies deserve much credit for accurate records and statistical data containing the proof.

While all of this has been going on what has happened in the field of preventive medicine in industry? The benefits derived from preventive measures have been, for the most part, an unrefined by-product of medical service, organized for the management of compensation risks. For example, the pre-employment physical examination as carried on by 65 per cent of the largest industries in the country is designed largely to determine the presence of impairments which may become compensable rather than to detect early disease processes and arrest their development. While the routine examination is rarely found to be a part of a program of preventive medicine in industry, such an examination, if well done, often reveals preclinical signs, correctable defects, and indications for effective treatment.

Our surveys for the past 3 years show that nearly 30 per cent of the industries having 500 or more employees provide periodic examinations on all or certain groups of workers, principally those who are exposed to occupational disease hazards and individuals in which a checkup of special functions, such as vision and hearing, are essential for efficient service and safety.

Therefore, the pre-employment and periodic physical examinations, in most cases, serve as preventive measures secondary to the major objective —the management of compensation cases.

Reliable authorities estimate that time lost on account of illness by the gainfully employed in the United States is 250,000,000 days per year, which is twelve to fifteen times greater than the time loss due to compensable injuries. A small number of industries have taken this enormous loss into account and initiated methods to curtail it. Their reports on the beneficial results of a program of preventive measures, based on a 5 year experience, show that absenteeism due to illness has been reduced from 8 to 4 days per employee per year.

A firm belonging to the textile group reported that the installation of modern air conditioning equipment in a new building had proved not only advantageous to the manufacture of its product, but also effective in the reduction of lost time of workers, due mainly to respiratory diseases.

Unfortunately, there had been no record kept of the time loss before or after the installation of the equipment, but the management observed the unquestioned decrease in illness and lost time.

The head of a progressive industry stated that the company had employed an engineer for 30 years to maintain the physical plant and estimate the loads which the warehouses and stock rooms could carry safely, but it was not until 4 years ago that the plant physician was instructed to estimate by periodic health examinations the physical reserve of the executives and the work load which they could carry. The results of these preventive measures have been so satisfactory that the periodic health examination is now a fixed procedure.

When a few industries tell us that time, money, and health are conserved by means of a practical program of preventive medicine, when reliable authorities tell us that an effective health program would save industry $1,000,000,000 per

year, why is there not a more active participation in a program of health conservation, especially in these days of thrift and economy?

One may readily understand why there is illness and loss of time on account of some occupational diseases and other ailments in which the cause is obscure or the prevention difficult, but it is hard to realize that certain well known occupational diseases such as lead poisoning are still causing illness and loss of time while the etiology and prevention are so well known.

The *Industrial Bulletin of the New York State Department of Labor* reported recently that an examination of a group of lead workers revealed clinical evidence of lead poisoning in 40 per cent of the cases. Laboratory tests confirmed the diagnosis in two-thirds of the cases, while the symptom complexes in the remaining one-third were probably due to other causes. The report states further that "absorption may be revealed in advance of symptoms and careful laboratory tests would dispose of about two-thirds of the perplexing causes. With laboratory evidence of active lead absorption and symptoms perhaps due to other causes, the assumption that an etiological relationship with lead probably exists would be warranted and compensation justified."

We may conclude from this statement that someone will pay not only for the cases of lead poisoning, but also for those which simulate this disease by the so called symptom complexes. Perhaps this expense could have been avoided by the use of well known preventive methods.

The following observations were made during the course of the surveys:

1. The question of cost and saving to the company arises first of all. While the medical department may venture an estimate, it is impossible to interpret the value of medical service on a monetary basis. Furthermore, in past years few companies have kept a record of their loss of time due to illness to compare with the results under a program of preventive medicine, so the actual saving cannot be computed accurately in order to justify the expense of the medical service.

2. The medical service in numerous industries is supplied by the insurance carrier whose contract includes the care of compensation cases only. Where these insured companies provide a physical examination prior to employment, it is done more to exclude the potential risks for compensation than to make a health inventory.

3. The doctor's connection with industry is often not close enough to allow him to carry on efficient work in preventive medicine—especially if the physician is on a part time or call basis. He is usually summoned to treat injuries only and his remuneration is adjusted accordingly. Oftentimes he is not familiar with working conditions so the company relies more on regular employees to handle problems of sanitation, illumination, occupational disease and other health hazards without medical consultation or advice.

4. Some doctors who accept positions with industry confine their energies to the practice of curative medicine. They do not have sufficient interest or experience in the field of preventive medicine to advise the adoption of its principles or to demonstrate its usefulness.

5. Industry may rightfully question the extent of its obligation in matters of preventive medicine. It may contend that preservation of health is a job belonging to local or public health authorities.

6. Many employers refrain from assuming any medical supervision of the workmen beyond that which is required by compensation law on the grounds that such a policy is an encroachment upon the individual's personal liberty.

7. Frequent labor turnover, unemployment, and labor controversies are detrimental to the establishment of a successful medical service.

There has been a liberal interpretation of the compensation laws for several years; there is now a definite trend to enlarge the list of occupational diseases and make them compensable; and it is not a far cry to predict that in time the compensation laws may be extended to include pneumonia, heart disease, or any other disease which may develop during the course of employment.

In view of this trend to expand the compensation laws, the preparation of more complete records on incidence of disease, time loss, and results of applied methods in preventive medicine would be helpful in the control of these conditions and aid in establishment of a fair and equitable law for occupational diseases. Only a small number of the industries visited prepare an analysis of illness among employees. Even the records of time loss due to illness are usually incomplete or lacking. Important information of this nature may be tabulated readily by the use of a daily work sheet without additional expense or the employment of extra personnel.

In these changing times there is need for concerted effort on the part of public health agencies, physicians, and industries to apply the principles of preventive health measures effectively in order to avoid waste and assist in the solution of the newer problems of industrial medicine. Otherwise, the law and non-medical agencies may handle the problem in a way which may prove to be less satisfactory to all parties primarily concerned.

TRAUMATIC LONGITUDINAL SINUS LESIONS

Report of Two Cases

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From the Departments of Neuro-Surgery and Pathology, University of Maryland School of Medicine

A GREAT deal has been written about cerebral trauma. The high death rate in certain types of cases indicates that there is still room for study, with the hope of better results in the treatment of the very severe injuries. There still remains a large group of cases in which the prognosis is grave from the very beginning, and it is in this group that complete postmortem study should be made. These studies in cases without serious injury to the skull usually reveal large hæmorrhages over the surface or in the substance of the brain, extensive contusions and lacerations of the brain substance, or small hæmorrhages in very vital areas, such as the brain stem. Accurate diagnosis is essential in the patients with small lesions such as is shown in Figure 2. Obviously nothing can be accomplished by operation, and a useless surgical procedure should not be undertaken. Operation certainly can do no good, and on the other hand may aggravate serious brain stem symptoms in a patient in which the hæmorrhage is small and may ultimately be absorbed. The gravity of the symptoms increases during the first few days because of the œdema of the area surrounding the hæmorrhage. If the patient can survive this period of œdema, absorption of the actual extravasated blood will take place. Figure 3 is a section of the brain stem in the neighborhood of the hæmorrhage shown in Figure 2. The reaction in this fatal case is seen to be very clear with complete destruction of many cells. This patient died on the fifth day after the accident. The symptomatology of this group of cases has been discussed in a previous communication and will not be discussed further here.

I wish here to record 2 cases of longitudinal sinus injury. In one the postmortem findings revealed a thrombosis of the longitudinal sinus,

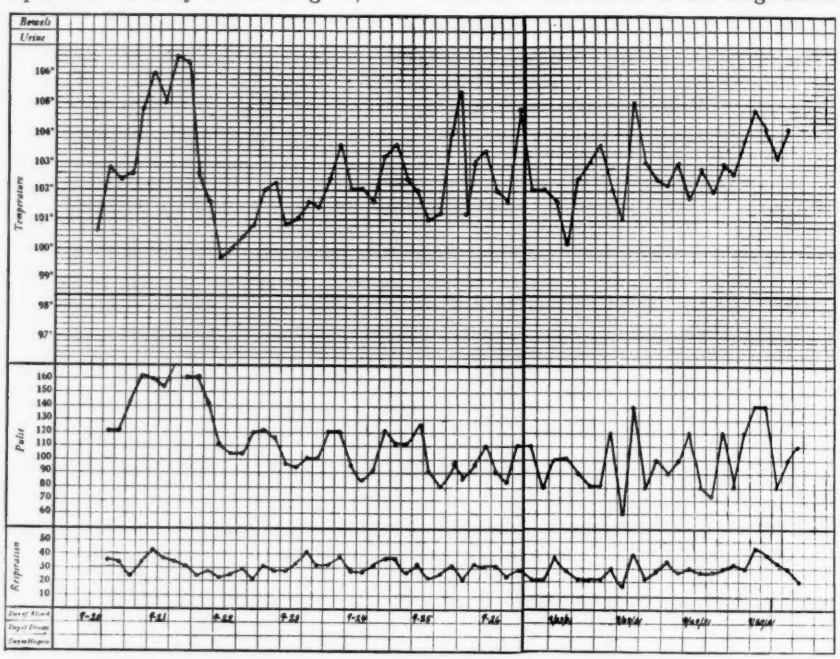

Fig. 1. Clinical chart, Case 1, showing the early sharp rise and continued elevation of temperature and of the pulse and respiratory rate.

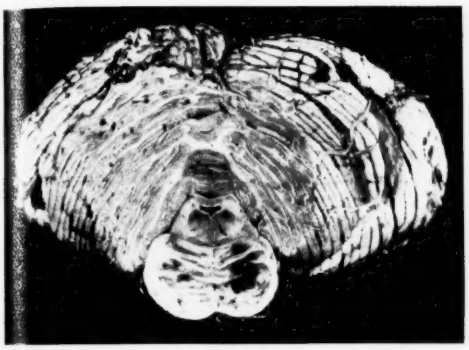

Fig. 2. Photograph showing small extravasations in the brain stem, the result of trauma. This extravasated blood was the sole cause of death. The symptoms presented were very characteristic of this type of lesion.

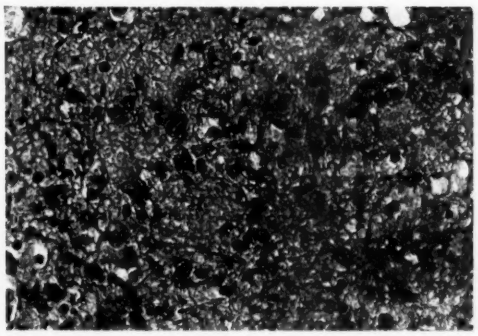

Fig. 3. Section of brain stem adjacent to the area of hæmorrhage shown in Figure 2, showing very extensive cell alteration and œdema. Reaction of this type extended far beyond a small blood clot.

and in the other the patient survived and the diagnosis of longitudinal sinus injury was based on the severe bleeding following elevation of a small portion of bone near the torcula, and herniation of the brain with evidence of increased cerebral tension subsequently.

CASE 1. Injured in automobile accident. Unconscious, marked elevation of temperature, rapid pulse and respiratory rate, many convulsive seizures, death on tenth day. Autopsy.

W. C. B., aged 9 years, was admitted to the Maryland General Hospital under the care of Dr. C. Reid Edwards, after being struck by an automobile. On admission he was unconscious and thrashing about. On the left side of the head there were two abrasions of the scalp, but X-ray examination did not reveal a fracture of the skull. Shortly after admission there was a general convulsive seizure which was ushered in by extreme rigidity of the extremities, first on one side and then on the other. Later there were strong convulsive movements of all parts of the body. These seizures occurred several times daily, lasting from one minute to one hour, until the day of death. During the intervals between the seizures he was restless, with bowel and bladder incontinence, and he never regained consciousness. Rectal temperature on admission was 100.6 degrees F., with a pulse rate of 120 per minute, and a respiratory rate of 35 per minute. There was a gradual rise of temperature, and 28 hours after admission the temperature was 106.6 degrees, and the pulse rate was 160 per minute with continued rapid respiration. From this time on the temperature varied, but the range was generally high, and the same may be said of the pulse and respiratory rate (Fig. 1). Lumbar puncture at the time of admission showed bloody cerebrospinal fluid, 20 cubic centimeters of which were withdrawn. Four punctures were done during the course of the illness without improvement in the symptoms. The cerebrospinal fluid pressure ranged only slightly above normal. Death occurred 10 days after admission.

The clinical picture in this case was not an unusual one in fatal cases. An early sharp rise in temperature after an accident has long been considered a bad prognostic sign. The very troublesome convulsive seizures were rather unusual. Each seizure was preceded by a period of tonic muscular contraction which lead one to believe that the cerebral irritation was of a different type from that evidenced in the usual convulsive seizures. Because of the low cerebrospinal fluid pressure we concluded that there was not a large blood clot and that nothing was to be gained by operation. The lack of improvement after lumbar punctures and the removal of bloody cerebrospinal fluid contra-indicated a more thorough drainage through a subtemporal decompression.

The autopsy findings were interesting and I think sufficiently uncommon to justify this report. There was no evidence of fracture of the skull. When the dura was removed, the veins emptying into the longitudinal sinus were tremendously distended (Fig. 4), the left hemisphere of the brain had a dark, bruised appearance, and the longitudinal sinus was bulging and tense and found to be the seat of a blood clot extending from the torcula forward about two-thirds of the length of the sinus (Fig. 5). A section of the clot as shown in Figure 6 shows beginning organization, but the thrombus is not complete, and one wonders if re-establishment of the circulation through the sinus would have occurred if the patient had survived. In this patient the severe convulsive seizures contributed largely to the fatal outcome. After hardening in formalin, the brain was sectioned and areas of extravasated blood were seen throughout the hemispheres, varying in size from clots measuring 1 by 2 centimeters (Fig. 7) to microscopic lesions (Fig. 8).

CASE 2. Small depressed fracture of external occipital protuberance, severe bleeding after elevation of fragment, cerebral herniation, amputation of herniated portion of left occipital pole almost 3 months after the accident, later herniation, which has persisted. Recovery.

M. E. P., aged 21 years, while standing at a gas station, was struck by an automobile and fell backward. A circular

Fig. 4. This photograph was made after fixation in formalin and shows the marked dilatation of the cortical veins.

Fig. 5. Photograph of the dura showing the firm clot in the posterior extremity of the longitudinal sinus and the marked dilatation of the cortical veins as they enter the dura.

piece of bone about the size of a twenty-five cent piece at the external occipital protuberance and slightly to the left was driven entirely within the cranium (Fig. 9). It is supposed that the patient's head struck a bolt of one of the tanks. He was immediately admitted to the Frederick City Hospital under the care of Dr. Edward P. Thomas. His condition at the time of admission was good. The patient was fully conscious. The removal of the bone fragment was followed by very severe hæmorrhage which was

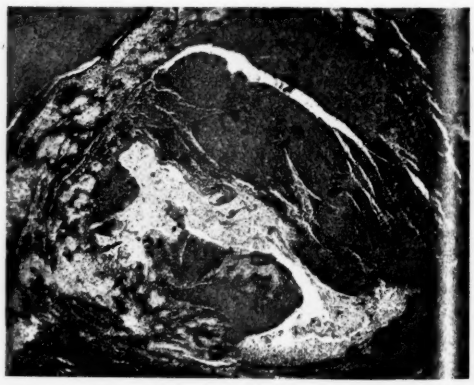

Fig. 6. Photomicrograph section of clot in longitudinal sinus. There is beginning organization, but the large area of red blood cells indicates that some blood was passing through the sinus.

controlled with packs. Forty-eight hours later, with Dr. Thomas, I slowly removed the packs through the original bony opening. There was no visible clot, but a rent in the dura about 1 centimeter in diameter was present at the left edge of the posterior extremity of the longitudinal sinus. Below this the left lateral sinus was visible and apparently normal. The patient complained of blindness on the right side and the visual fields later disclosed a complete right homonymous hemianopsia. After removal of the packs there was no bulging of the cortex through the dural tear, but when the dressings were removed a few days later the scalp was elevated slightly. This elevation continued to increase and 4 weeks after the accident it was as large as a lemon, the cerebral cortex was beginning to break through the incision, and there was constant drainage of clear cerebrospinal fluid. At this time the patient was transferred to the Church Home and Infirmary in Baltimore, where his chief complaint was diplopia, blindness on the right side, and the presence of the "lump" in the left occipital region. Examination of the optic discs showed definite blurring with overfilling of the veins. During the 4 weeks after admission the patient remained in bed, was purged freely, and the wound dressed daily. The small fungating area was completely covered by epithelium and the drainage of cerebrospinal fluid ceased. The bulging, however, remained about the same, and the slight choking of the optic discs noted on admission was increased. With the hope of further reducing the mass, lumbar punctures were done at intervals of from 1 to 4 days, and the cerebrospinal fluid pressure ranged from 250 to 150 millimeters of water. Seven lumbar punctures in all were done over a period of 20 days, but in spite of this the bulging persisted, and at times became very tense, when there was again slight drainage of cerebrospinal fluid. Eighty-three days after the accident the bulging mass was amputated through the original opening in the occipital bone. The amputation was simple with the electrocautery. Bleeding was not troublesome. A small protective drain was placed in the lower angle. This was removed and the opening closed with a black silk suture 48 hours after the operation. The amputated stump measured about 2 centimeters in diameter and showed no tendency to bulge. The condition of the patient was very satisfactory, and 48 hours after the operation a lumbar puncture revealed slightly bloody cerebrospinal fluid under a pressure of 195 millimeters of water. On the fifth day, the patient suddenly became very ill, complaining of severe headache, very troublesome vomiting, and his temperature rose to 103.6 degrees F. Pulse and respiratory rate were quick. There was stiffness of the neck. At this time there was bulging at the site of the operation. The patient remained in this condition for 6 days, during which time he was unable to retain anything by mouth, was extremely apprehensive, and the pulse was weak and rapid. From this point on he gradually improved, though the bulging continued, reaching about one-third the size of the original mass which had been removed.

Frequent lumbar punctures were done during convalescence as an aid in the reduction of the cerebrospinal fluid pressure. He was discharged from the hospital 5

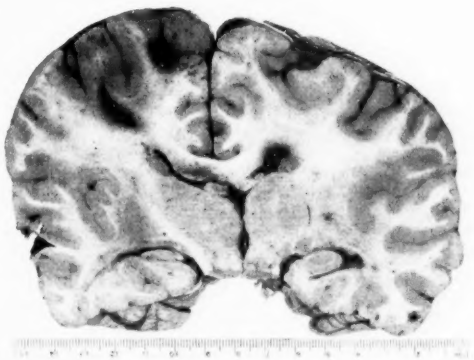

Fig. 7. Frontal section of the brain showing small clots, one at the depth of a sulcus and another in the brain substance.

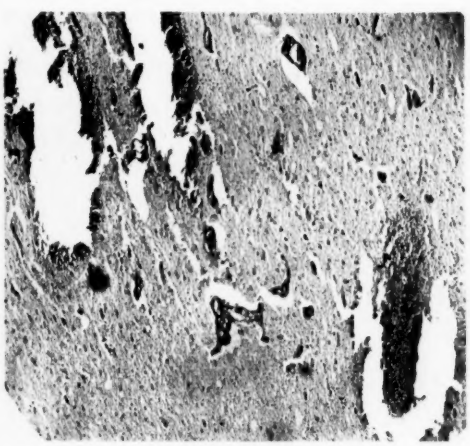

Fig. 8. Photomicrograph showing that as the result of venous stasis the brain substance was the seat of extensive extravasations of this type.

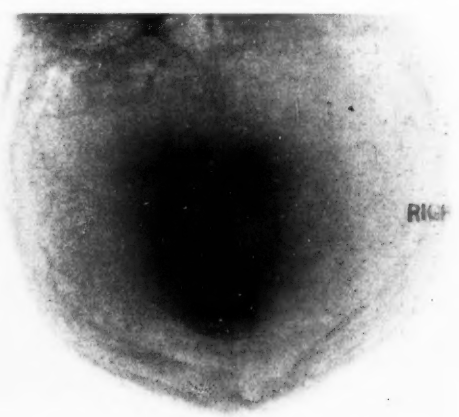

Fig. 9. X-ray picture, Case 2, showing the skull defect at the site of the indriven fragment of the external occipital protuberance.

months after the accident in very good general condition, but with a small bulging mass in the occipital region and a complete right homonymous hemianopsia. It is now 6 months since he left the hospital, the bulging is slowly diminishing, the general condition is excellent, and the complete right homonymous hemianopsia persists.

The diagnosis of longitudinal sinus injury and partial obstruction in this case is based upon the location of the lesion as shown in Figure 9; the severe bleeding when the bony fragment was elevated, the rent in the dura on the left edge of the longitudinal sinus noted when the packs were removed, and the subsequent bulging of the cortex are probably the result of partial occlusion of longitudinal sinus. It is hoped that the venous drainage will gradually improve and that the herniation, which is gradually receding, will entirely disappear.

SUMMARY

Two cases of partial obstruction of the longitudinal sinus are reported. In Case 1 the acute symptoms were very severe and the patient died on the tenth day. In this patient the obstruction to the venous circulation of the cortex was sufficient to cause extravasations of blood into the brain substance with marked cerebral irritation, severe convulsive seizures, and death.

In Case 2 the obstruction resulted in a moderate increase in intracranial pressure, which is gradually diminishing and will probably return to normal with the disappearance of the herniation.

THORACIC INJURIES

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INJURIES to the thorax may be produced by blunt force or by penetration. Blunt trauma is due to sudden impact as from a blow or collision or explosion, or from a crushing or bursting pressure. In civilian life penetrating injuries most commonly are caused by knife stabs or gunshot missiles, depending somewhat on local custom. Automobile and railroad accidents and those incident to various industries present greatly varied types of both blunt and penetrating trauma.

Injuries to the thorax may threaten life not only through immediate cardiac inhibition, shock, or hæmorrhage, but also because of mechanical interference with the vital functions of respiration or circulation. Serious infection may supervene if the patient survives the immediate crisis. Differentiation of types of injuries that demand immediate operation from those that require the most active supportive treatment may be very difficult. There may be serious complicating abdominal or cranial injuries necessitating early operative intervention. In view of such multiplicity of possible complicating factors thoracic injuries would therefore seem to merit special consideration.

This presentation will deal first with the nature and differentiation of the more important lesions, irrespective of their mode of origin, and then with some of the more important principles of treatment. Such lesions include fracture of ribs, shock, hæmothorax, pneumothorax, traumatic empyema, pulmonary abscess, and diaphragmatic hernia. Atelectasis, hæmopericardium, cardiac injuries, compression ecchymosis, and traumatic chylothorax are more unusual.

Fracture of ribs. Simple fracture of one rib occurs frequently. It is recognized by painful respiration and by exquisite tenderness over the fracture. Complicated fracture in which the ends of the rib fragments are driven into the lung may result in emphysema, pneumothorax or hæmothorax, or both, and treatment is essentially that of the complication. Multiple rib fractures due to great violence usually are associated with such complications in addition to shock. Fracture of the sternum is relatively uncommon.

Shock. The typical picture of traumatic shock is a familiar one. However, in case of thoracic injury irritation of the vagus nerve, and possibly of the thoracic sympathetics, may complicate the picture. An initial slow, full pulse due to such vagus stimulation may lead one to underestimate the seriousness of the injury. In one such instance in my observation the patient was able to give a clear account of the automobile accident in which he was injured. A few hours later he was dead of shock. Sudden deaths have been reported following apparently trifling injuries in which necropsy has failed to show adequate cause of death. These are usually considered as cases of fatal air embolism or of "pleural reflex." If the patient survives the later symptoms resemble shock, in the ordinary sense of the word.

Hæmothorax. Hæmorrhage may result from any type of injury but most frequently from penetrating wounds. The bleeding is usually into the pleural cavity. It may be from a ruptured intercostal, mammary, or azygos vessel, from a great vessel, or from the lung or hilus. Several factors promote continuous bleeding into the pleural cavity. Among these are the negative intrapleural tension which tends to aspirate the blood out of the bleeding vessels, the elasticity of the lung which causes it to recede as the blood accumulates thus offering no pressure to limit bleeding, and the respiratory movement particularly during coughing which favors continued bleeding from the lung. The smooth endothelial lining of the pleural cavity also delays coagulation of accumulated blood. As a result a hæmothorax of large proportions may result from a relatively small bleeding vessel.

Pneumothorax results from the admission of air into the free pleural cavity. The air may pass through the chest wall from a laceration of the lung. It may be open or closed. In an open pneumothorax the air has free entrance and exit either through the chest wall or through the lung surface. A closed pneumothorax is one in which air has entered the pleural cavity and the opening through which it gained entrance has closed. Penetrating wounds of the chest wall, without evidence of injury to the lung, are often accompanied by a partial pneumothorax, presumably from a momentary leak. The opening into a bronchus through an injured lung usually becomes closed by the consequent collapse of the lung. A tension pneumothorax is one in which there is a valve-like arrangement, usually in case of a laceration of the lung surface, which allows air to enter the pleural cavity but prevents its

escape. At each inspiration more air will enter the pleural cavity until the pressure in it becomes atmospheric. But in proportion as one lung collapses the respiratory excursions must be increased in order that a compensatory amount of air may enter the other lung. This again lowers the pressure of the pneumothorax to below atmospheric and more air enters it. A vicious circle is thus established, augmented by coughing and straining, resulting in constantly increasing volume of the pneumothorax until the tension becomes greater than atmospheric and the mediastinum is forced to the opposite side to such an extent as to incapacitate the other lung, sometimes to such a degree that asphyxia results. In one such case under my observation, that of a child 5 years of age, the positive pressure on the pneumothorax side registered between 20 and 30 cubic centimeters of water. The mediastinum in this instance was apparently sufficiently rigid to enable the other lung to function adequately. In another similar case the patient died of asphyxia before the condition was recognized.

A hæmopneumothorax is the most common complication of penetrating injuries. In a series of 341 penetrating injuries reported by Boland, 261 due to knife stabs and 78 due to gunshot missiles, hæmothorax was produced in 49, pneumothorax in 52, and hæmopneumothorax in 108.

Empyema. A sterile pleural effusion may be superimposed on a pneumothorax or a hæmothorax. Empyema is a frequent complication of thoracic injury. Pneumothorax predisposes to empyema by lessening the resistance of the pleuræ to infection, and hæmothorax furnishes a favorable culture medium for bacterial growth. An infection of the pleural cavity may gain entrance through a penetrating injury of the chest wall, particularly if an open, sucking pneumothorax exists, or it may come by way of a bronchus or from a late infection of a lung injury. Foreign bodies in the lung may also lead to a late infection of a primary sterile hæmothorax. A traumatic empyema incident to a complete collapse of the lung is usually a much more serious condition than an ordinary postpneumonia empyema, owing to the large area of infected pleura and rapidity of toxic absorption.

Injuries to the lung. The lung may be injured not only by penetrating bodies and gunshot missiles, but also by blunt force. A crushing injury in case of a child or young adult with very elastic ribs and cartilages may result in a bursting of the lung much as a rubber balloon may burst on sudden compression. In an individual with more rigid bony thoracic cage, fracture of ribs is the rule. Blunt force may also produce a contusion of the lung which in turn may lead to a capillary hæmorrhage and œdema. Such lesions of the lung have been observed, not only following direct impact of blunt force producing no superficial evidence of injury, but also following explosions.

Laceration of the lung surface produces hæmorrhage which accumulates in the pleural cavity unless the injured part of the lung is adherent to the chest wall. The amount of bleeding is in proportion to the depth and extent of the injury. Leakage of air from the lung may result from a relatively small injury to it. I have observed pneumothorax repeatedly following an exploratory aspiration of the pleural cavity in which the possibility of air entering the thorax through the needle could be excluded. Such a pneumothorax must be due to an injury to the lung surface by the needle point. If there are pleural adhesions in the area of lung injury emphysema may be produced which may be subcutaneous, subpleural, or mediastinal, depending on the site of the injury.

Pulmonary abscess. Trauma was the cause of pulmonary abscess in 23 (4.3 per cent) of 528 cases of abscess which I have studied. Blunt trauma may result as stated in actual rupture or in interstitial ecchymosis and œdema which may be followed by pneumonitis or gangrene. An example of an acute suppurative pneumonitis was that of a man who was stabbed in the chest five times with a slender ice pick 20 centimeters long. He died 3 days later of a virulent pulmonary infection.

The onset of symptoms of abscess is usually from one to five weeks after the injury, but the abscess may develop long after the primary lesion has healed. Abscess following retained gunshot missiles or other foreign material has been observed months or years after the original injury. In one case in my experience a piece of wood about 2½ inches long was removed through a thoracotomy incision for drainage of an abscess 10 years after an injury caused by a piece of board thrown from a buzz-saw. The patient had had no symptoms of pulmonary infection until 3 months before the operation.

Diaphragmatic hernia. Traumatic diaphragmatic hernia may be due to blunt trauma producing a bursting tear of the diaphragm, or it may be due to penetrating injury produced most often by a knife stab or by gunshot missiles. In a series of 857 cases of diaphragmatic hernia 51 per cent were due to trauma. Excluding 127 cases due to war injuries the proportion of traumatic hernias was about 43 per cent. The 730 civilian cases were almost equally divided between an etiology of penetrating and of blunt trauma. About 70 per

cent of the penetrating injuries were due to stabs in the lower thorax, 21 per cent to gunshot wounds. Of the non-penetrating injuries more than one-third were due to falls and nearly one-quarter to crushing injuries. In recent years there has been a marked increase in incidence of diaphragmatic hernia from automobile accidents. A few are reported which followed airplane accidents.

Shock and pain are the most characteristic immediate symptoms of traumatic hernia. Following penetrating injuries, hæmothorax or dyspnœa from pneumothorax are the most characteristic. The later symptoms vary greatly as to time of onset, character and degree of severity.

Many traumatic hernias are overlooked or wrongly diagnosed. Of 127 soldiers wounded during the late war who were later found to have diaphragmatic hernias over 40 per cent had symptoms 1 to 15 years before a diagnosis was made.

Differential diagnosis. Injuries of the chest wall, including fracture of ribs, pneumothorax, and hæmothorax, are usually obvious. However, the relative parts played by shock, continued hæmorrhage or a tension pneumothorax, in the production of early acute symptoms may be very difficult to evaluate. The nature and extent of injury to the lung can be estimated only by the symptoms produced. Vagus stimulation should be considered if the patient presents himself with a slow, full pulse after a seemingly serious injury. In such cases the pulse will later take on the characteristics of severe shock.

Very severe symptoms following apparently trifling injury, on the other hand, may be in the nature of air embolus or "pleural reflex." An intrapleural hæmorrhage assuming proportions that threaten life are manifested by the signs and symptoms of severe hæmorrhage, with signs of fluid in the thorax crowding the heart toward the opposite side. In tension pneumothorax there is an increasing dyspnœa with physical and X-ray evidence of pneumothorax and of marked displacement of the heart to the opposite side. An exploratory needle connected with manometer will at once establish the diagnosis of a tension pneumothorax. Hæmoptysis or a tension pneumothorax in the presence of an intact chest wall is definite proof of injury to the lung, but there may be serious injury to the lung without either of these complications. The possibility of combined thoraco-abdominal injuries should always be suggested by injuries involving the lower thorax or by a penetrating injury of unknown extent or direction. Symptoms of sepsis after the first 24 hours may be due to beginning empyema, pneumonia, abscess, or peritonitis. Retained foreign bodies, as pointed out, may give rise to secondary infection months or years after injury.

Treatment. A patient presenting himself with the picture of shock should be treated for that condition, but the possibility of associated internal hæmorrhage as a contributing factor should always be kept in mind. Increasing pallor, a steadily-climbing fast pulse, and physical evidence of an increasing hæmothorax, call for transfusion first, then thoracotomy for controlling hæmorrhage, and, in case of severe laceration of the lung, for repair of that condition. Hæmorrhage is the most frequent cause of death during the first 24 hours after thoracic injuries.

An open pneumothorax through which air rushes in and out during respiration must be closed at once by any means at hand, such as a simple dressing and adhesive strapping, until proper operative closure can be accomplished. A closed pneumothorax of moderate size requires no treatment. The air will absorb spontaneously. If large enough to produce symptoms of mediastinal displacement air should be aspirated until the manometer reading becomes atmospheric or slightly less.

A tension pneumothorax proved by manometer readings or by the rush of air out of the aspirating needle can be relieved temporarily by simply allowing the air to escape or by aspirating it, but if increasing dyspnœa develops repeatedly an open thoracotomy is indicated for closure of the valve opening.

A hæmothorax that does not produce symptoms of blood loss or dyspnœa from crowding the mediastinum to the opposite side should be left undisturbed at least for several days. Aspirating the blood at once will produce re-expansion of the lung in proportion to the amount of blood withdrawn, and this may lead to recurrence of the hæmorrhage which may be serious if superimposed on previous blood loss. A recurrent leakage of air from a communicating bronchus may also result. Dyspnœa and cardiac displacement may, however, necessitate aspiration of a portion of the hæmothorax to relieve the mechanical embarrassment to the other lung.

Fever, rising pulse, and leucocytosis after the first 24 hours may mean an infected hæmothorax, or an infected pleural effusion in case no hæmothorax exists, or it may signify a pneumonia or traumatic pneumonitis or abscess. Smear and, if necessary, culture of the exudate will determine whether or not an infection is present. It is important to recognize that an infection may be present in aspirated blood that shows no suggestive physical change.

A traumatic empyema, as stated, is of more serious import than the ordinary postpneumonia type from the standpoint of both prognosis and treatment. Complicating a pneumothorax with complete collapse of the lung, the infection involves the whole pleural cavity, and the resulting toxic absorption is correspondingly great. Such empyemas are also prone to become chronic due to the early tendency for the lung to become fixed in the collapsed position.

One factor responsible for the re-expansion of the lung collapsed by an empyema is intrabronchial positive pressure which is produced by coughing, or by straining. This factor becomes especially effective when there is a coincident less than atmospheric intrapleural pressure. In case of a wide open pneumothorax this relationship, which tends to hold the expansion produced by intrabronchial positive pressure, is lost. Any type of closure of the pneumothorax opening will tend to re-establish it. The other factor promoting re-expansion of the lung in empyema is the progressive adhesions of the pleuræ around the perimeter of the cavity. As long as the lung is completely collapsed there is no contact of the pleuræ except at their mediastinal reflection; consequently this factor is entirely lost. Lacerations of the lung are prone to recurrent bleeding when infection supervenes in the associated hæmopneumothorax. Traumatic bronchial fistulæ also may persist, complicating treatment and delaying healing of the empyema.

The closed method of drainage with hypochlorite solution irrigation is especially suitable for empyema complicating pneumothorax pulmonary collapse. The extensive suppurating pleural surfaces can be kept washed clean, the hypochlorite exerts a bactericidal effect, and the aspiration of the fluid until a less than atmospheric intrapleural pressure is produced assists in the re-expansion of the lung. The end of the drainage tube if kept under water between irrigation acts as a water valve to allow air to escape when the patient expands the lung by straining, etc., but prevents its return, thus keeping up a negative intrapleural tension. If lung injury is present the closed method with salt solution or non-irritating antiseptic solution irrigation should be used in the early stages of treatment. If there is a persistent bronchial fistula open drainage with silver nitrate stick cautery to the bronchial stoma will usually prove sufficient for its closure. Dakin solution irrigation may then be used.

Traumatic massive gangrene of the lung is usually rapidly fatal. Lung abscess formation manifests itself by cough and purulent sputum. Such abscesses will usually lie in the parenchyma of the lung which renders them suitable for open drainage treatment.

A hæmothorax that persists uninfected should be aspirated after the acute symptoms have subsided, because of the massive thickening of the pleura which may result if the blood is left in the pleural cavity until spontaneously absorbed.

Injuries involving the lower thoracic walls, particularly of the penetrating type, or if signs or symptoms of abdominal injury develop, should be explored through a thoracotomy incision. An injury to the diaphragm can then be enlarged and any damage to the upper abdominal viscera ascertained and attended to. Any injury to the diaphragm should be carefully repaired on account of the resultant predisposition to diaphragmatic hernia.

ABDOMINAL INJURIES

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WITH the advent of motor-driven vehicles, farm machinery, and mechanical motorization of industry, the number of abdominal injuries has increased. As the speed of vehicles and machines increase, so will the number of serious abdominal injuries, as statistics for the coming decade will show. The many complications and multiple injuries encountered make the treatment of these patients very difficult and taxes to the utmost the ingenuity and skill of the most experienced and talented surgeons. Early diagnosis and operative treatment when indicated are absolutely necessary if life is to be saved. Procrastination and indecision on the part of the surgeon or practitioner in the 2 or 3 hour period immediately following the trauma not infrequently results fatally. Many of these patients are in extreme shock with hæmorrhage. Unfortunately, if shock from operation is added the mortality rate is very high. Regardless of the degree of shock and hæmorrhage, however, in certain cases, unless immediate operation is done, death is inevitable. Every possible effort should be made to make a diagnosis in these cases without delay so that a decision can be made as to whether operative or non-operative treatment should be employed. A differential diagnosis of intra-abdominal or extra-abdominal trauma is imperative. If extra-abdominal or extraperitoneal, the treatment in the vast majority of cases is non-operative. If the trauma involves the abdominal organs, decision as to whether operation should be done should be made after every symptom and factor involved has been studied and evaluated.

Rupture of the hollow viscus. Perforation of the stomach and large or small intestine requires immediate operation with repair of the rupture by suture. If the rupture is extensive, resection of the intestine may be necessary. Every minute of delay increases the chances of fatality. Operations performed after 8 to 12 hours or more almost always offer no hope for the reason that peritonitis is well established. A valuable diagnostic symptom in these cases as well as in those of intraperitoneal rupture of the bladder, is the presence of air in the dome of the diaphragm which can be demonstrated by the X-ray. X-ray films should always be taken if there is any doubt as to the diagnosis.

Rupture of the mesentery. We have encountered tears of the mesentery without rupture of viscera. Extensive hæmorrhage is very often associated with very severe pain which is referred to the back and is not controlled by morphine. The treatment in such cases is immediate ligation of bleeding vessels and suture of the mesentery or resection of the bowel in severe cases. Sedatives should never be given until the diagnosis has been made because the symptoms may thus be masked.

Retroperitoneal hæmorrhage. Not infrequently a diagnosis of intra-abdominal injury is made only to be proved incorrect by findings at operation. Retroperitoneal hæmorrhage which frequently complicates low back injuries, should obviously not be treated by non-operative methods. The symptoms of hæmorrhage simulate those of intestinal paresis, i.e., rigid abdomen, distention, and diminution of peristalsis, and these symptoms present themselves within the first few hours. It is only by wide experience that one is able to make a differential diagnosis between intraperitoneal and extraperitoneal trauma. Failure to do so is most certain to result in fatality.

Rupture of the liver. A large or small hæmorrhage is usually encountered in these cases. If from the clinical evidence the hæmorrhage is small, operation is not indicated. If the condition is critical, with every evidence of extensive hæmorrhage, operation with suture or gauze pack, or both, is indicated.

Rupture of the spleen. The diagnosis of this condition frequently is overlooked. Treatment indicated in a slight rupture is non-operative with rest in bed for 4 to 6 weeks. Extensive, crushing injuries of the spleen demand immediate splenectomy at the earliest possible moment.

Rupture of the kidney. Rupture of the kidney which is seen rather frequently is relatively easy to diagnose. In most cases these injuries respond to palliative treatment, i.e., rest in bed with administration of urinary antiseptics. Should the hæmorrhage persist with constantly decreasing hæmoglobin of 50 per cent or below, transfusion followed by nephrectomy is usually indicated, provided the kidney is traumatized beyond repair. Rest in bed for 6 to 8 weeks should be a routine measure in the treatment of kidney rupture because there is a tendency to secondary hæmorrhage if the patient is active too soon.

One should at all times keep in mind the patient's general physical condition, as well as his

hæmoglobin, blood-count and status of the urine. For some weeks after the macroscopic blood disappears, microscopic blood is found in the urine.

Intraperitoneal rupture of the bladder. Frequently intraperitoneal rupture of the bladder is complicated by the presence of rupture of other organs or fracture of the pelvis. The diagnosis is rather easy. Laparotomy should be performed at once, the rupture closed by suture and the institution of intraabdominal drainage together with drainage of the space of Retzius. Bladder drainage through the urethra should also be instituted following the operation.

Extraperitoneal rupture of the bladder. Extraperitoneal rupture of the bladder is usually complicated by extensive extravasation of urine and blood in the cellular tissues of the pelvis and space of Retzius. The treatment consists of drainage of the bladder and space of Retzius.

Pneumatic perforation of the rectum. Compressed air has been the cause of death in some cases. For instance before the great danger was recognized workmen in jest would introduce the nozzle of the compressed air apparatus into and about the anus of fellow workmen. This caused death in some instances from perforation of the rectum, with secondary peritonitis. I have had 5 such cases on my service. In some cases, innocent but ignorant workmen used compressed air to dust off their clothing. If placed within 12 inches of the anus, compressed air at 40 to 60 pounds pressure, can and does produce rupture of the low sigmoid.

Immediately following the accident the abdomen becomes greatly distended as in profound shock. The history and physical signs are clearly indicative of the pathological condition present. Immediate operation with suture of the perforation and drainage is indicated. The operative mortality is high as a result of the extreme shock and peritonitis which ensues regardless of the operative procedure.

Contusions or hæmatoma of the abdominal wall without intra-abdominal injuries. Patients with contusions or hæmatomata of the abdominal wall without internal injuries are best treated by "watchful waiting." The prevention of adhesions, myositis and hæmatoma can be accomplished by the Morton Smart method of graduated muscle contraction. If this treatment is followed for 10 days, it assists greatly in the rapid absorption of the hæmorrhage and lymph, and this materially reduces the convalescent period.

As previously stated, indecision and delay in making the diagnosis and in instituting treatment often deprive the patient of his one chance for recovery. An absolute and positive diagnosis cannot always be made and any surgeon, regardless of his experience and knowledge, can profit by consultation. No time should be lost in deciding on and outlining treatment if life is to be saved.

TRAUMA OF THE SPINAL COLUMN

FRED H. ALBEE, M.D., Sc.D., LL.D., F.A.C.S., NEW YORK

CERTAIN anatomical and physiological characteristics of the spinal column are of practical importance not only in determining the nature of physical injury from trauma but also in planning its appropriate treatment. Situated between the vertebral bodies are the resilient intervertebral discs in the central portion of each of which is located the nucleus pulposus.

The nucleus pulposus is a fibrogelatinous material subject to the laws of fluids. It is incompressible and held to its normal shape by the strong and elastic annulus fibrosus. It is the elastic tension of the annulus fibrosus which tends to extrude its contents when the disc is ruptured or sectioned. The pressure of the nucleus pulposus contents in the living is not only the result of the elastic tension of its water, but that of the muscle tone and weight-bearing forces transmitted from one vertebral body to the other. The function of the nucleus pulposus depends upon the integrity of its limiting walls, viz., the cartilage plates above and below and the annulus fibrosus. The incompressibility of the nucleus pulposus contents determines that any diminution in vertical diameter of the intervertebral disc must result from the change of shape of the nucleus pulposus by the yielding of the elastic annulus fibrosus. Therefore, the amount of vertical yielding of the intervertebral disc will depend upon the elasticity of this structure. Only minor changes in contour take place under the forces to which it is ordinarily exposed. The intervertebral disc, however, possesses sufficient resiliency to absorb shocks transmitted along the vertebral column.

The most frequent lesion of the spine, according to Schmorl, is the extrusion of the contents of the nucleus pulposus into the spongiosa of the vertebral body. The nuclear material may be forced through a crack in the cartilage plate into the spongy bone by the impact of the trauma which is transmitted to that disc by the weight of the body and continued by the contraction or tone of the spinal muscles or ligaments. As a result of this invasion, local destruction of the bone may result. A cartilage nodule forms around the semifluid material and the bone about it becomes sclerosed, resulting in a secondary line of defense to wall off the invading material. This sclerosed area may be visualized in the roentgenogram, but sufficient time must have elapsed following the prolapse of the nuclear material for the reaction in the bone to take place, or a diagnosis by X-ray cannot usually be made.

The extrusion of even a very small amount of the semigelatinous nuclear material may result, at an early age, in dehydration of the disc and diminished function. This has been demonstrated by the studies of Pueschel and has been confirmed by Keyes and Compere. Such small ruptures may be a contributing etiological factor in the development of chronic arthritis of the spine.

In the event of the escape of a considerable portion of the semifluid material either into the spongy bone or through the fibers of the annulus fibrosus, the weight of the body no longer can be transmitted in this way from one vertebral body to the other, but must be borne partially by the fibrocartilaginous annulus fibrosus. The intervertebral disc progressively becomes thinner and may disappear almost entirely. The destruction of the nucleus pulposus causes the axis of motion to be shifted posteriorly to the articular facets and the weight of the body is transferred to the anterior portion of the vertebral bodies. As a result the adjacent vertebræ may become sclerosed and osteophytes or spurs characteristic of osteoarthritis of the spine may occur.

Injury of the cartilage plate is often associated with fracture of the vertebral body. X-ray studies have not revealed any lesion of the vertebræ following trauma, but months or years later, when symptoms of backache have persisted, roentgenological investigations have shown marked collapse of a vertebral body with narrowing of one or both adjacent intervertebral spaces.

The extrusion of nucleus pulposus material from trauma is undoubtedly one of the frequent etiological factors resulting in painful backs and disability.

The reparative potentiality of vertebral bone is much less than that of most, if not all, other skeletal bones. This is strikingly emphasized by the failure of union of fractures of lateral and articular processes when the fragments are in the best of apposition and conditions otherwise favorable. The absence of bone growth in tuberculous involvement of vertebral bone and the condition known as Kuemmell's disease is evidenced by extensive disappearance, even to the extent of several vertebral bodies with slight coincident bone growth or repair. These factors must be taken into consideration in planning the treatment as

well as the convalescence of spinal column fractures.

Inasmuch as one of the chief functions of the spinal column is the protection of the spinal cord, it was undoubtedly nature's plan that vertebral bone should not tend to excessive callus because of the danger of encroachment upon the cord and the spinal nerve roots. This low osteogenesis on the part of vertebral bone has been explained from an embryological standpoint by Willis,[1] who claims that vertebral bone, in part at least, is derived from the ectoderm whence come in general tissues of high differentiation and low reparative potentiality such as spinal nerve tissue, etc. The skeletal bones are derived from the mesoderm whence come tissues of low differentiation but high reparative possibilities.

These are basic facts and should guide the surgeon in choosing material for fusion purposes or in the management of trauma to bone. This vertebral bone is poor material for fusion and likewise when fractured is slow to unite, so much so that sometimes it is necessary to graft bone from elsewhere.

The two big subdivisions are fractures (a) with cord involvement; (b) without cord involvement.

a. A patient with cord involvement should be placed immediately in hyperextension, with or without anæsthesia or traction to the head and feet, in accordance with the degree of bony displacement and difficulty of reduction.

In the event of complete loss of cord function my position is that, as long as the neurologists and roentgenologists are unable to give trustworthy opinions as to whether the cord is completely or partially destroyed or whether absence of function is due to irritation or pressure, I shall do early laminectomies and give the patient the benefit of the doubt. However, one must realize fully that under these conditions personal statistics will be very poor. I will cite briefly only one case to illustrate my point. Some 15 years ago I saw at the Mary Fletcher Hospital a young man with complete paralysis below the waist. The history was that 4 days before while working as lineman for the local electric company he had fallen about 9 feet from a pole after contacting a live wire. X-rays in two planes gave no help. A neurologist and surgeon had recommended against surgical interference. At laminectomy I found a block of bone in the neural canal. Its removal resulted in ultimate complete recovery.

General speaking, asymmetry of motor involvement is a favorable indication of partial or complete cord recovery.

[1] Am. J. Surg., 1929, No. 6, 163–168.

b. Of the fractures not associated with cord injury, time will permit the consideration of only one, and that is compression fracture of the vertebral body. In these cases I employ immediate hyperextension, with or without anæsthesia or traction on head and feet in accordance with the degree of bone crushing or displacement and difficulty of reduction. This can be accomplished by the use of a frame, plaster-of-paris jacket, Dunlop's method, etc. This usually accomplishes: (1) reduction of fracture fragments and restoration of vertebral body contour; (2) a tendency to prevent slow extrusion of the semigelatinous material from the nucleus pulposus in the event that there is a rupture, a condition which it is impossible to diagnose at first by X-ray or otherwise.

After 2 weeks of hyperextension in cases of severe crushing, or especially in patients of athletic tendencies desirous of a rapid recovery, a bone graft operation may be elected or the hyperextension may go on for an additional 12 weeks. After this procedure activity should be encouraged and should be associated with physical therapy. If symptoms persist, indicating nerve root irritation or pressure or non-union, a late bone graft operation should be done. If immediate operation is done the recumbency may be shortened to 6 weeks, and the patient may be immediately allowed to get about without either brace or plaster.

A case was seen in consultation some years ago which illustrates my attitude as to whether or not operation should be done in certain contingencies. An active, athletic male, 28 years old, had been thrown from his horse while playing polo, and a severe compression fracture of the body of the twelfth dorsal vertebra was found. Two conflicting opinions arose: one was to have the young man lie upon a gaspipe frame for 4 months, followed by a plaster-of-paris cast for a period of 3 months; the other was to have a tibial bone graft inlaid into the spinous process of the fractured vertebra and the neighboring ones on each side. The insistence of the patient that he wished to return at the earliest possible moment to polo and other athletic games was the deciding factor in recommending immediate operative fixation. Some patients who are not athletes choose the operation because of its greater reliability of getting them back to work at a much earlier date. I have relieved patients of pain and weak spines by implanting grafts even after a lapse of 10 years. It is necessary that every effort be made to make the period of convalescence shorter than usual.

REHABILITATION OF THE INJURED

FREDERICK J. GAENSLEN, M.D., F.A.C.S., MILWAUKEE, WISCONSIN

IN the brief time allotted for the presentation of the subject assigned to me I will make no attempt to discuss in detail any one type of injury, but will attempt to describe a few simple methods which we have found useful in the rehabilitation of the injured in our orthopedic practice. These methods will be found to be widely applicable, simple in technique, and available for the most part at a trifling cost. They can be readily taught by the attending surgeon to the patient himself or to the layman of average intelligence.

To begin with, it will probably be agreed that normal function requires not only a normal anatomical mechanism, but one which is kept at par by a reasonable amount of daily use. This is axiomatic. A broken bone or a torn ligament will interfere with or abolish function of the part; on the other hand, an extremity fixed for a long period in plaster or splints will forfeit temporarily not only mobility but also strength. This applies not only to the contracting muscle cell, the connective tissue of the supportive ligaments, but also to the bone itself. The latter, after weeks of disuse, will become markedly atrophied. Whereas the roentgenogram of the normal bone shows a dense white cortex of normal thickness and density, that of the bone suffering from atrophy of disuse appears ghost-like in comparison, the cortex being much thinner and less dense, while the cancellous bone casts a shadow scarcely deeper than the surrounding soft parts. This fact has sometimes been made use of clinically in the correction of deformities of the lower extremities, notably in bow-legs. While one would have considerable difficulty in breaking a bowed tibia in an otherwise normal child of 4 or 5 years of age, it would be relatively easy to break such a leg at almost any desired point after encasement of the member in a closely fitting plaster cast for a period of 6 weeks. The point in this discussion is that a given structure receives enough nourishment for its actual needs and no more. The muscle in the athlete hypertrophies because of constant demand. The muscle is deep red in color because of rich blood supply, while the muscle not used is pale in color and flabby in consistency. This is noted especially in the muscles which have been paralyzed, partially or completely, after an attack of poliomyelitis.

What holds true for the individual part holds true for the body as a whole. In a normal, resting individual the cardiac output has been estimated at 3 to 5 liters of blood per minute. In an oarsman, during strenuous exercise, the output has been estimated at 34 liters per minute. It is quite likely that the demands of a normal, active individual as compared to that of a person confined to bed for a long period are roughly proportional to these figures. The blood supplies oxygen and nutriment and carries away carbon dioxide and waste products. Growth, repair, defense against infection, are favored by an adequate blood supply and retarded by an insufficient supply. Shutting off the circulation means necrosis or gangrene of the part. A slowing of the blood stream occasionally leads to clotting in the larger veins, notably of those of the lower extremities and pelvis. The records of most of our larger hospitals show a number of deaths each year from pulmonary embolism resulting from the loosening of such clots and the carrying of these through the inferior vena cava to the right heart, thence into the pulmonary artery where they may block one or more of the larger branches with severe symptoms and not infrequently cause death.

The indications, therefore, are to keep the circulation as near par as possible, not only that of the part, but that of the body as a whole. This may be accomplished by systematic exercises. In every case of long confinement to bed, if the individual recovers at all, there must be a time when it is safe and wise to use mild, gradually increasing exercises. This holds true not only for the injured but for any individual suffering from chronic disease, and I would include pulmonary tuberculosis, chronic heart disease, chronic arthritis, and, in fact, the great majority of diseases which may be incapacitating for long periods. The importance of these considerations has been recognized for many years in isolated clinics, but it is only rarely that one sees anything more than desultory attempts at carrying out a suitable program in our modern hospitals. Bardenheuer was an early advocate. The writer recalls visiting his clinic in Cologne in 1912. He made it a rule that when he entered his fracture ward the patients immediately started in with exercises of trunk and extremities, not of the injured parts encased in plaster or splints, but of the uninjured parts, to keep up the general tone. There is no reason why a person confined to bed for long periods should not carry out certain exercises for

uninvolved extremities or trunk. He should be instructed to open and close his fists fifteen to twenty times in a rapid, moderately forceful manner; to flex and extend the wrist; to supinate and pronate the hand; to flex and extend the elbow. All the muscles controlling the shoulder joint may be exercised by three motions, usually described to the patient as the "flying" motion, requiring use of the abductors and adductors, the "sawing" motion, utilizing the forward and backward elevators of the shoulder, and the "fanning" motion, requiring the use of the rotators. In like manner the lower extremities, if not encumbered with apparatus, are made to execute simple movements designed to compel the use of the muscles controlling the hip, knee, ankle, and toes. These exercises should be outlined carefully by the attending surgeon and carried out at first either under his own direction or that of nurse or attendant, later by the patient himself without supervision but according to a definite schedule. A healthful fatigue promotes sleep so that sedatives are required less frequently. It also improves the appetite, thus insuring sufficient intake to meet the demands for repair.

Exercise of an injured member requires careful adjustment to avoid undue strain on the injured part. In the case of a fracture of the femur just out of splints there is insufficient power to raise the heel from the bed with the knee extended. But if a sling is put about the ankle and the patient can assist the lift by means of an overhead pulley and cord, flexion and extension of the hip and knee may be executed without danger of injury. By holding the extended leg in mid air by means of the rope and pulley abduction and adduction readily can be carried out. These so called pendulum or sling suspension exercises are very valuable in starting an exercise program since the slightest degree of power can be translated into motion without fear of strain or injury. They are readily adaptable both to upper and lower extremities and include opportunity for exercise of the larger joints, shoulder, elbow, hip, and knee.

Another method is to attach a roller to the heel. At first we used the wheels of a roller skate, more recently a caster attached to the heel in such a manner that with the weight of the extremity carried largely by the cord and pulley, gentle movements in abduction and adduction, flexion and extension could be carried out, at first very gently through a small arc of motion and later more forcibly and through a wider range. Resistance can be offered by the attendant as increased effort on the patient's part is warranted.

A horizontal bar suspended from a Balkan frame is being used a great deal and is of value in maintaining the general muscle tone as well as in adding to the patient's comfort by enabling him to raise himself on the bed pan and to shift his position without calling for help from the nursing staff. Under water exercises have been very helpful to us. We have had a large bath tub, a so called Hubbard tub, installed in one of the rooms at Columbia Hospital. This tub is of such shape that the extended arms and legs can be moved into complete abduction. An overhead trolley system enables the patient, lying on a canvas carrier, to be shifted to a position directly over the tub and gently lowered into the water. While it was at first questioned whether it would be wise from an economic standpoint to set aside a room for this purpose, I believe that this room at present is used as much as any room in the hospital. After removal of a body cast for a fracture of the hip, patients thoroughly enjoy the experience of a bath after two or more months of partial sponge baths. They are encouraged by the painlessness of the first gentle movements and are eager for a daily repetition of the experience.

While the beneficial effects of such simple exercises for normal as well as injured parts are readily appreciable to the patient, as well as to the physician and attendants, and presumably attributable to improvement of circulation, it is desirable to have some scientific explanation for this improvement. Moving pictures of the circulation in the rabbit's ear and the effect of a rise of surrounding temperature on the circulation, prepared by Doctors Elliot R. Clark and E. A. Swenson of the anatomy department of the University of Pennsylvania, are of interest in this connection. These show that, while at ordinary temperature the circulation through the capillaries is slow, one may say sluggish, a moderate rise in temperature is accompanied by a very marked increase in the rate of flow. That exercise exerts a similar influence is indicated graphically in the charts prepared at the Mayo Clinic, based on the work of Goldschmidt and Light. These show that the number of open capillaries in a given area of skin surface is more than doubled by exercise, that heat also increases their number, while cold decreases their number in marked degree. "In this connection, too, the work of Wright and Marquardt is of interest. They studied the capillaries in the nail bed of the finger and found that while in a normal, active individual the capillaries were rather closely packed in hairpin-like loops, those of the crippled arthritic hand were much less numerous and nar-

rower, indicating that the little used, crippled hand was receiving a minimum of blood."

We have, then, clinical as well as scientific evidence that increased blood supply goes with normal activity in the normal part and diminished blood supply is to be expected in the crippled inactive part.

Since much of our work is in connection with fractures a special word may be permitted. Whereas in fractures of shafts of the long bones one generally may look forward with peace of mind to good function if the alinement is good and apposition only fair, the situation is entirely different in the case of fractures into joints. An offset in the articular surface at a weight bearing point means a traumatic arthritis with gradual increase in severity and marked pain and disability. I will show on the screen a roentgenogram of a fracture of the lower end of the tibia extending into the joint. This fracture had been well reduced, but weight bearing had been permitted and advised at the end of eight weeks. This resulted in a shifting upward of the anterior fragment, resulting in a step-like ridge on the lower articular surface of the tibia directly over the summit of the dome-shaped astragalus. The result, as could have been expected, was a traumatic arthritis, constant pain, and marked disability which required an arthrodesis, or stiffening of the ankle, shown in the next slide. Instances of these and similar types in which ill-advised early function leads to disaster can be multiplied. We are firm believers in early motion, but this must be guarded carefully and timed properly. Just Lucas-Championniere, the author of "Treatment of Fractures by Mobilization and Massage," is often quoted as the champion of early motion; but he used the very gentlest massage and began with minimal degrees of motion, for the most part under his own supervision or that of specially trained attendants. It is possible that with suitable skeletal fixation, such as Kirschner wires, earlier mobilization of neighboring joints may be possible, but the greatest caution will always be necessary to avoid the unwelcome complications of displacement and non-union.

In conclusion, no one will question that adequate blood supply is essential if repair after injury or disease is to progress at normal rate. No one will question that exercise, often wisely combined with heat, massage, and hydrotherapy, will improve circulation and thus hasten repair. The curious thing is that these simple truths, which one scarcely feels justified in reciting, are so often lost sight of in the rehabilitation program. One should, as often has been said, think in terms of function throughout the course of treatment. If fixation is necessary, this should be reduced to a minimum and with the parts in the most advantageous position for future function. Foot-drop, back-knee, adduction contracture of the shoulder, are all too frequently annoying and disabling complications and, I think, readily avoidable. Good alinement is more essential in fractures of shafts of weight bearing bones than is apposition. In fractures into joints there is little margin for error. A discrepancy in a weight bearing joint surface of one-eighth inch may be fatal to function. No amount of physical therapy will prevent a disabling chronic traumatic arthritis. In our teaching we should stress the fact that simple physiotherapeutic measures, utilizing heat, massage, exercises, and hydrotherapy will accomplish a great deal of good. In the exceptional case more elaborate equipment is desirable. Larger hospitals should have such equipment and the necessary operating personnel, but there is no good reason why a community workshop should not solve the problem for the smaller hospital. This means a saving both in equipment and in personnel and will meet the need in the great majority of cases at a minimum of cost.

CO-OPERATION OF RAILWAY CHIEF SURGEONS WITH THE STANDARDIZATION OF MEDICAL SERVICE IN INDUSTRY

JOHN R. NILSSON, M.D., F.A.C.S., Omaha, Nebraska

I HAVE been requested to say a few words in regard to the co-operation of the railway chief surgeons with the standardization of medical service in industry. Dr. Besley has presented this subject of standard medical service in industry to our chief surgeons. I am sure that every chief surgeon will co-operate with the plan outlined and will make such changes in his medical personnel as are necessary and practical to conform with the plan outlined by Dr. Besley.

In the "Fracture Symposium"[1] Dr. Kennedy has enumerated several of the activities of the Medical and Surgical Section of the American Railway Association. Therefore I will not repeat them at this time, but will simply discuss one or two of the activities.

At the present time the medical and surgical section of the American Railway Association has a fracture committee which has met with a similar committee from the American College of Surgeons in order to formulate some standard plan for the transportation of the injured. The committee from the College at their first meeting advised equipping all trains, passenger and freight, with Thomas splints. Our committee, however, could not agree to go on record recommending to the American Railway Association the placing of Thomas splints on all trains. With 625 railroads members of the American Railway Association, and many finding it necessary during the past 2 years to borrow from the Government a total sum of $300,000,000, the questionable expenditure of the amount necessary to equip all trains at the present time was thought unwise and prohibitive. This, coupled with the fact that many railway surgeons are not familiar with the Thomas splint and its application, impelled the decision of our committee that it was inadvisable to make this recommendation at that time. Those of us who spent some time in service abroad during the War know that the Thomas splint is the ideal splint for the transportation of persons with injured extremities.

In 1921 at the annual meeting of the American Railway Association it approved the following recommendation of its Medical and Surgical Section. That wherever possible only hospitals rated as Class A by the American College of Surgeons be recognized, and, where railroads have their own hospitals, that such institutions not already so classified be brought to such a standard. Speaking more specifically for my own railroad, the Union Pacific, of which I have been chief surgeon for a number of years, I will say that it has always been my desire some day to be able to report to our railroad executives and to the American College of Surgeons that every hospital on the Union Pacific Railroad where our employees are treated for either sickness or injury, is recognized and standardized by the American College of Surgeons. It also has been my desire to be able to say to them that every surgeon on our railroad authorized to do major surgery upon our employees is a Fellow of the American College of Surgeons. I am proud to say at this time that every hospital on our railroad (fifteen in number) where our employees are cared for from Council Bluffs, Iowa, through the states of Nebraska, Kansas, Missouri, Colorado, Wyoming, and Utah, meets the standard of the American College of Surgeons and that all surgeons in the same states authorized to operate upon any of our many thousands of employees are now Fellows of the American College of Surgeons.

Our emergency stations have all been improved, being supplied with proper transportation splints, oxygen tanks, etc.

One of our greatest difficulties has been in having our fracture and bedside records kept up properly, but progress has been made in this respect since all hospitals are now standardized and records closely checked at the end of each month before filing.

Probably the greatest service that the railroad medical departments render their respective railroads and the public, other than caring for the sick and injured, is the close supervision over the physical condition of the operating personnel by the periodic physical examination of employees in the engine, train, yard, station and signal service. Approximately 10,000 employees are examined every 2 years by a full time physician who travels over the railroad in an examination car especially equipped for that purpose. Of the 625 railroads which are members of the American Railway Association 51 now are conducting these periodic physical examinations. The Union Pacific was one of the first railroads to put these periodic examinations into effect, 21 years ago. Our railroad

[1] Printed elsewhere in this issue.

occupies a position of unmistakable leadership in accident prevention. The physical condition of the employees revealed by these free examinations is undoubtedly an important factor in keeping their performance up to requirements, and by keeping the men physically fit we probably do much toward the prevention of accidents.

It seems to me that if the standardization program which has been outlined by the American College of Surgeons can be carried out in the case of a large railroad organization covering several states, it should be comparatively easy to standardize completely the medical service in other industries.

COMMITTEE AND DEPARTMENT REPORTS

DEPARTMENT OF CLINICAL RESEARCH—ALBERT J. OCHSNER MEMORIAL

BOWMAN C. CROWELL, M.D., CHICAGO
Associate Director, American College of Surgeons; Director of Clinical Research

THE work in clinical research which is being conducted by the College includes that of the following committees:

Committee on the Treatment of Malignant Diseases,
Committee on the Archives of Malignant Diseases,
Committee on Bone Sarcoma,
Committee on Clinical Laboratories,
Committee on Fractures,
Board on Industrial Medicine and Traumatic Surgery,
Board on Medical Motion Pictures.

A survey of the work of this department which has been performed during the past year is embraced in the reports of the individual committees.

COMMITTEE ON THE TREATMENT OF MALIGNANT DISEASES

ROBERT B. GREENOUGH, M.D., BOSTON, Chairman

THE usual meeting of this Committee is set for Wednesday, October 11, 1933, so that no change in the policy or conduct of the affairs of the Committee is to be recorded today. The survey of established cancer clinics has been continued, and the thanks of the Committee are gratefully accorded to Dr. MacEachern for his assistance and co-operation, and that of the members of his department in carrying out these responsibilities.

Advice and assistance to hospitals in relation to the proposed organization of cancer clinics has also been provided by Dr. Crowell from the central office, and by individual members of the Committee. Dr. Crowell will submit to the Board of Regents the list of the clinics which the Committee considers entitled to the approval of the College, and of others to which it is felt provisional approval can be given.

With this report the present chairman of the Committee would respectfully request that his resignation of that office be accepted and that he be excused from further service in the ensuing year.*

The personnel of the Committee on the Treatment of Malignant Diseases is as follows:

Robert B. Greenough, Boston, Chairman
A. C. Broders, Rochester, Minn.
Curtis F. Burnam, Baltimore
George W. Crile, Cleveland
Bowman C. Crowell, Chicago
William Duane, Boston
Edwin C. Ernst, St. Louis
Rupert H. Fike, Atlanta
John M. T. Finney, Baltimore
Burton J. Lee, New York
Frank W. Lynch, San Francisco
Henry K. Pancoast, Philadelphia
H. Gideon Wells, Chicago
Francis C. Wood, New York

*The resignation of Dr. Greenough as Chairman was accepted by the Board of Regents and Dr. Burton J. Lee, New York, was appointed to succeed him.

STANDARDIZATION OF CLINICAL LABORATORIES

AT the meeting of the Committee on the Standardization of Clinical Laboratories, held in October, 1926, the following Minimum Standard for Laboratories was adopted and has been approved by the Board of Regents:

1. That the clinical laboratory shall be under the direction of a graduate in medicine, especially trained in clinical pathology.

2. That the clinical laboratory shall be prepared to perform satisfactory work in (a) histopathology; (b) bacteriology and parasitology; (c) serology; (d) hæmatology, and (e) chemical and morphologic examinations of other body fluids, exudates, transudates, and excreta.

3. That all tissues removed at operation shall be examined in the laboratory and reports rendered thereon.

4. That an easily available copy of all reports shall be filed in the laboratory and one with the patient's record. In histopathology there shall be in the laboratory a cross index of, at least, the name of the patient, of the hospital or laboratory number of the patient, and of the lesion or organ. There shall be preserved also, for at least three years, either section, embedded tissue, or gross tissue from each case from which tissue is removed.

5. That a uniform system of charges for laboratory work shall be enforced.

6. That the clinical pathologist shall attend the monthly staff conferences of the hospital.

CANCER CLINICS APPROVED TO OCTOBER 1, 1933

IN 1930, the Board of Regents of the American College of Surgeons, on the advice of its Committee on the Treatment of Malignant Diseases, announced its policy of emphasizing the necessity of making the benefits of contemporaneous knowledge of cancer available to each and every cancer patient in the country. Already existing hospitals were recognized as the natural centers in which modern diagnostic and therapeutic procedure should be conducted, and a minimum standard was formulated for cancer clinics in such hospitals.

Information concerning the cancer clinic movement of the College was published, and all approved hospitals of one hundred or more beds were urged seriously to consider their organization. Representatives of the College have visited the hospitals, have consulted with members of their medical staffs and administrators, and have furnished to the College a summary of the activities of each hospital with regard to the diagnosis and treatment of cancer. Ordinarily, these hospitals have the personnel and equipment for such service, but we believe that a definite organization for this special service is of advantage in obtaining the maximum of efficiency in the campaign against cancer.

The College now announces a list of the hospitals which are conducting cancer clinics which conform to its minimum standard. The conduct of such clinics varies somewhat according to the character of the hospital with regard to whether its patients are charity patients or otherwise. Some institutions have established diagnostic clinics but refer the patients elsewhere with advice as to the nature of treatment that should be administered. In certain other large institutions some departments have organized cancer clinics for the recognition and care of cancer in their patients while other departments have not so organized. Cognizance of these facts is taken in the publication of the list of institutions that are approved from the standpoint of their cancer clinics.

It is further recognized that certain institutions have accepted the minimum requirements for cancer clinics as formulated by the American College of Surgeons and are endeavoring to carry them out, but for lack of time or other acceptable reasons have not yet been able to do so in every detail. In the following list they are indicated as having "provisional approval."

The publication of this list of 140 approved cancer clinics in no way indicates that effective cancer treatment cannot be obtained elsewhere, but serves to show that these institutions have formally organized for this purpose as part of a countrywide campaign in behalf of the cancer patient.

In addition to the list of approved cancer clinics the College has information concerning 60 other cancer clinics which for one reason or another are not yet ready for a rating by the College, and still 102 other hospitals have definitely signified their contemplation of the formation of such clinics.

Approved cancer clinics in general hospitals	75
Provisionally approved cancer clinics in general hospitals	51
Hospitals with departments conducting approved cancer clinics	4
Approved cancer diagnostic clinics	10
Total approved cancer clinics	140
Total cancer clinics surveyed	200

MINIMUM STANDARD FOR CANCER CLINICS IN GENERAL HOSPITALS

1. *Organization.* There shall be a definite organization of the service, and it shall include an executive officer and representatives of all the departments of the hospital which are concerned in the diagnosis and treatment of cancer. The services of a secretary and of a social service worker shall be available.

2. *Conferences.* As an essential feature of the service there shall be regular conferences or consultations at which the diagnosis and treatment of the individual cases are discussed by all members of the clinic who are concerned with the case.

3. *Patients.* Reference to the cancer clinic of all patients in whom the diagnosis or treatment of cancer is to be considered shall be either voluntary or obligatory in accordance with the vote of the medical staff or of the governing board of the hospital.

4. *Equipment.* In addition to the diagnostic and therapeutic surgical equipment which is required in every approved general hospital there shall be available an apparatus for X-ray therapy of an effectiveness which is generally agreed upon as adequate, and an amount of radium sufficient to insure effective treatment.

5. *Records.* In addition to the records which are required in every approved general hospital, there shall be additional records of: (a) The details of the history and of the examination for cancer in different regions of the body, such as are indicated on the form records which are recommended by the Committee on the Treatment of Malignant Diseases, American College of Surgeons; (b) The details of the treatment by radium or X-ray as indicated on the form records which are recommended by the Committee on the Treatment of Malignant Diseases, American College of Surgeons; (c) Periodic examinations at intervals for a period of at least five years following treatment.

6. *Treatment.* The treatment of cancer patients shall be entrusted to the members of the staff of the cancer clinic except in cases in which adequate treatment in accordance with the collective recommendation of the staff of the cancer clinic can be procured otherwise.

HOSPITALS CONDUCTING APPROVED CANCER CLINICS

California

Los Angeles—*California Hospital
Hollywood Clara Barton Memorial Hospital
Oakland—Highland Hospital of Alameda County
Pasadena—*Pasadena Hospital
San Francisco—*University of California Hospitals

Colorado

Denver—*St. Luke's Hospital

Connecticut

Bridgeport—Bridgeport Hospital
Hartford—Hartford Hospital
*St. Francis Hospital
New Haven—*New Haven Hospital

District of Columbia

Washington—*Freedmen's Hospital
Garfield Memorial Hospital
Georgetown University Hospital
*Providence Hospital

Georgia

Atlanta—Steiner Clinic
Thomasville—*John D. Archbold Memorial Hospital

Illinois

Chicago—*Cook County Hospital
Mercy Hospital
Michael Reese Hospital
*St. Bernard's Hospital
University of Chicago
Hines—Veterans Administration Hospital

Kentucky

Louisville—J. N. Norton Memorial Infirmary
St. Joseph's Infirmary

Louisiana

Shreveport—Shreveport Charity Hospital

Maryland

Baltimore—Howard A. Kelly Hospital
University Hospital of the University of Maryland

Massachusetts

Boston—*Beth Israel Hospital
Collis P. Huntington Memorial Hospital
Massachusetts General Hospital
New England Deaconess Hospital
Peter Bent Brigham Hospital
Brookline—Free Hospital for Women
Fall River—*Truesdale Hospital
*Union Hospital in Fall River
Wrentham—Pondville Hospital at Norfolk

Michigan

Ann Arbor—University Hospital
Battle Creek—Battle Creek Sanitarium
Detroit—Grace Hospital
*Harper Hospital
*Woman's Hospital
Eloise—Eloise Infirmary
Grand Rapids—*Blodgett Memorial Hospital
*St. Mary's Hospital

*Provisionally approved.

Minnesota

Minneapolis—University Hospital
Rochester—Mayo Clinic
St. Paul—*Northern Pacific Beneficial Association Hospital

Mississippi

Vicksburg—*Vicksburg Sanitarium and Crawford Street Hospital

Missouri

Kansas City—*Menorah Hospital
St. Louis—Barnard Free Skin and Cancer Hospital
Barnes Hospital

Montana

Butte—Murray Hospital

Nebraska

Omaha—Creighton Memorial, St. Joseph's Hospital

New Jersey

Newark—Hospital of St. Barnabas
Newark Beth Israel Hospital
*Newark Memorial Hospital
Paterson—Paterson General Hospital

New York

Albany—Memorial Hospital
Brooklyn—Brooklyn Cancer Institute
Buffalo—Buffalo City Hospital
State Institute for Treatment of Malignant Diseases
Kingston—*Benedictine Hospital
New York—Custodial Hospital
*Lincoln Hospital
Memorial Hospital for the Treatment of Cancer and Allied Diseases
Montefiore Hospital
New York City Cancer Institute Hospital
*St. Luke's Hospital
Sloane Hospital for Women
Stuyvesant Square Hospital
Woman's Hospital in the State of New York
Port Chester—United Hospital
Rochester—*Strong Memorial Hospital
Valhalla—Grasslands Hospital

Ohio

Akron—*City Hospital of Akron
Cincinnati—*Cincinnati General Hospital
Cleveland—City Hospital
Cleveland Clinic Hospital

Oregon

Portland—*Good Samaritan Hospital
Multnomah Hospital

Pennsylvania

Allentown—*Allentown Hospital
Clearfield—*Clearfield Hospital
Harrisburg—*Harrisburg Hospital
Meadville—*Spencer Hospital

PHILADELPHIA—American Oncologic Hospital
*Frankford Hospital
Graduate Hospital of the University of Pennsylvania
Hahnemann Medical College Hospital
Jeanes Hospital
Jefferson Hospital
*Jewish Hospital
Lankenau Hospital
Philadelphia General Hospital
PITTSBURGH—Homeopathic Medical and Surgical Hospital and Dispensary
Pittsburgh Skin and Cancer Institute
*Presbyterian Hospital
*St. Francis Hospital
*St. Margaret Memorial Hospital
READING—*Reading Hospital
SCRANTON—Moses Taylor Hospital
WINDBER—*Windber Hospital
YORK—*York Hospital

RHODE ISLAND

PROVIDENCE—Rhode Island Hospital

SOUTH CAROLINA

CHARLESTON—*Roper Hospital

TENNESSEE

CHATTANOOGA—*Newell and Newell Sanitarium

TEXAS

DALLAS—Baylor University Hospital
SAN ANTONIO—*Robert B. Green Memorial Hospital
TEMPLE—*King's Daughters' Hospital
*Scott and White Hospital

UTAH

SALT LAKE CITY—*Salt Lake General Hospital

*Provisionally approved.

VIRGINIA

ROANOKE—Jefferson Hospital

WASHINGTON

SEATTLE—Harborview Hospital
Swedish Hospital

WEST VIRGINIA

CHARLESTON—*Mountain State Hospital

WISCONSIN

MADISON—*State of Wisconsin General Hospital
MILWAUKEE—Columbia Hospital

CANADA

ALBERTA

EDMONTON—*Royal Alexandra Hospital

MANITOBA

ST. BONIFACE—St. Boniface Hospital
WINNIPEG—Winnipeg General Hospital

ONTARIO

KINGSTON—Ontario Institute of Radiotherapy, Kingston General Hospital
TORONTO—Toronto General Hospital

QUEBEC

MONTREAL—Institut du Radium
Montreal General Hospital

SASKATCHEWAN

SASKATOON—Saskatoon City Hospital
REGINA—Regina General Hospital

CHINA

PEIPING—Peiping Union Medical College Hospital

HOSPITALS IN WHICH DEPARTMENTS ARE CONDUCTING APPROVED CANCER CLINICS

MICHIGAN

DETROIT—Henry Ford Hospital

NEW YORK

NEW YORK—Presbyterian Hospital
Roosevelt Hospital

QUEBEC, CANADA

MONTREAL—Royal Victoria Hospital

HOSPITALS CONDUCTING APPROVED CANCER DIAGNOSTIC CLINICS

CALIFORNIA

SAN FRANCISCO—Mary's Help Hospital

ILLINOIS

CHICAGO—Northwestern University

MASSACHUSETTS

BOSTON—Boston Dispensary

MISSOURI

ST. LOUIS—DePaul Hospital
St. Louis City Hospital

NEW HAMPSHIRE

MANCHESTER—Elliot Hospital

NEW YORK

LONG ISLAND CITY—St. John's Long Island City Hospital
MIDDLETOWN—Elizabeth A. Horton Memorial Hospital

OHIO

COLUMBUS—Columbus Cancer Clinic

PENNSYLVANIA

NORRISTOWN—Montgomery Hospital

REGISTRY OF BONE SARCOMA

BOWMAN C. CROWELL, M.D., CHICAGO, Registrar

THERE have been 162 cases submitted to the Registry during the last year. Of these, 140 cases have been registered. On 405 of the cases which have been circulated during the year, opinions have been rendered by 28 doctors. The total number of cases in the Registry is now 1,544, classified as follows:

Osteogenic sarcoma	722
Ewing's sarcoma	162
Myeloma	63
Lymphosarcoma	7
Inflammation	75
Periosteal fibrosarcoma	25
Metastatic tumor	41
Angioma	11
Hæmangio-endothelioma	12
Benign giant cell tumor	291
Giant cell tumor, malignant	16
Benign osteogenic tumor	40
Unclassified and miscellaneous	53
Not bone tumors	17
Parosteal osteogenic sarcoma	4
Liposarcoma	5
	1,544

There are 432 cases of osteogenic sarcoma that were treated 5 years or more ago, and 105 cases of Ewing's sarcoma that were treated 5 years or more ago.

In March, 1926, Dr. Ernest Amory Codman, the originator and first chairman of the Registry of Bone Sarcoma, published twenty-five criteria for establishing the diagnosis of osteogenic sarcoma and 13 registered cases of "five-year cures" analyzed according to these criteria.

From time to time since then the Registrar has announced an increasing number of such "5-year cures" that have been registered. The present report presents 66 cases of osteogenic sarcoma and 9 cases of Ewing's sarcoma that have lived clinically free from the disease for periods of 5 years or more following treatment.

One (B.S.R. No. 100) of the original 13 cases reported by Codman died 11 years after treatment with metastases in the spine, ribs, and lungs, after having been clinically free of the disease for 10 years or more. The 12 other original "cures" are still alive and free from the disease at the time of the latest report.

Four of the other cases here reported have died after the expiration of the 5 year period; one (B.S.R. No. 1437) from cardiac and cerebral sclerosis, one (B.S.R. No. 176) following a prostatectomy, one (B.S.R. No. 970) with probable pulmonary metastases 8 years after treatment, and one (B.S.R. No. 156) died 9 years after treatment from heart disease without recurrence of the tumor.

At least 2 cases (B.S.R. Nos. 183 and 267) have had definite evidence of metastases which have disappeared after treatment.

Sixty-three of the 66 5-year cures of osteogenic sarcoma were treated by surgical methods, and of these 35 had surgical methods only. In the other 31 cases surgery was supplemented by radium or X-ray treatment or Coley toxins or some combination of these agents. In 14 of the cases Coley toxins were administered.

The cases in which amputation was not performed are as follows:

B.S.R. No. 668. Local excision of tumor of lower part of femur followed by radium.

B.S.R. No. 183. Local excision of tumor of lower part of tibia followed by radium and Coley toxins.

B.S.R. No. 523. Excision of tumor of ilium followed by radium.

B.S.R. No. 585. Tumor of ilium treated by X-ray only.

B.S.R. No. 109. Tumor of rib treated by resection followed by radium.

B.S.R. No. 373. Tumor of rib was explored and then treated by radium and Coley toxins.

B.S.R. No. 759. Tumor of scapula treated by excision and X-ray.

B.S.R. No. 867. Tumor of scapula treated by excision alone.

It is interesting to note that 18 of the cases had some form of operative procedure on the tumor at periods of 1 day to 5 years prior to amputation. These operative procedures consisted of single or multiple biopsies, curettages, explorations, excisions, or resections.

There are in the Registry 432 cases of osteogenic sarcoma that were treated 5 years or more ago. A percentage of the curability of the disease is not given as this series does not represent a consecutive series of cases treated, and there is a tendency for doctors to pay more attention to the registration of their unusually successful cases than to a registration of all of their cases.

EWING'S SARCOMA

Nine of the registered cases of Ewing's sarcoma have lived from 5 to 21 years following treatment. These cases occurred in a group of 105 registered cases of this disease.

All 9 cases were subjected to surgery. In 6 of them amputation was performed. In the 3 others there were excisions. Five of the 6 amputated cases also received Coley toxins and of these 4 had radiation in one form or another. Four of the 6 amputated cases had one or more surgical procedures at some period prior to the amputation.

The personnel of the Committee is as follows:

Dallas B. Phemister, Chicago, Chairman
Bowman C. Crowell, Chicago, Registrar
Edwin I. Bartlett, San Francisco
Everett L. Bishop, Atlanta
Joseph C. Bloodgood, Baltimore
Barney Brooks, Nashville
Ernest A. Codman, Boston
Charles L. Connor, San Francisco
James Ewing, New York
W. R. Galbreath, Porto Rico
Frank W. Hartman, Detroit
Henry W. Meyerding, Rochester, Minn.
John J. Morton, Rochester, N. Y.
Channing C. Simmons, Boston

COMMITTEE ON FRACTURES

FREDERIC W. BANCROFT, M.D., New York, Chairman

IN the time allotted to me it would be impossible to give a detailed account of the activities of the Committee on Fractures. I shall therefore mainly stress the important problems before this Committee.

The purpose of the committee is to stimulate interest in and to improve the treatment of fractures. It functions through two main channels:

I. Subcommittees of the general committee who report at the annual meeting of the general committee each year. Following are the subcommittees:

(a) Scientific—a presentation is made of the latest advances in research or treatment; (b) educational—both undergraduate and postgraduate; (c) regional groups; (d) physical therapy; (e) bone plates and screws; (f) American Railway Surgeons and American Red Cross; (g) editorial; (h) ambulance equipment.

II. Regional fracture groups established in various cities throughout the country. Each regional group has clinical and executive meetings for the purpose of stimulating interest in and improving the treatment of fractures. The general committee attempts to correlate and advise the various fracture groups.

The installation of the Keller-Thomas half-ring splints as necessary equipment of ambulances in New York and Philadelphia has been accomplished through the activity of the respective regional groups. The improvement of fracture services in hospitals, including equipment and personnel, the training of internes, the education of ambulance carriers in cities and rural communities are included in the program of the regional groups.

In the past fractures occurred largely in industrial communities and were mainly cared for by industrial surgeons. High speed locomotion, by airplane and automobile, has changed the picture. Accidents occur on highways and in towns and are often first seen by the general practitioner. The first aid treatment often may mean the difference between rapid union and delayed union. If a fracture is not reduced before œdema and hæmorrhage occurs, weeks of hospitalization may result. To meet this tragedy to health and economic life the efforts of this Committee must be directed largely along the following lines:

1. Undergraduate education. Medical schools have allotted far too little time to this important subject. Dr. Darrach, formerly dean of Columbia University, in his report of the subcommittee on education, has stressed the necessity of stimulating the faculties of universities to grant more time to this subject. We believe progress is being made, but there is still much to be hoped for.

2. Postgraduate instruction. Postgraduate schools should allot more time to teaching the practical side of fracture treatment. In the larger municipal hospitals the younger men are assigned to treat fractures. As they do not have to be members of the College to enter the regional fracture groups, they receive instruction and stimulus throughout the year without expense. In addition, the personal contact that they make with the older men is of great advantage. Certain regional groups have given concentrated practical fracture courses over a period of a week or longer. At the meeting of the American College of Surgeons in New York the regional group gave practical demonstration of the emergency treatment of fractures. At the present meeting in Chicago the local regional group is giving splendid demonstrations of an educational nature. The reprinting of the "Outline of the Treatment of Fractures" by the College in a much improved form will create an increasing demand from the practitioners throughout the country and will aid in the educational propaganda.

3. Regional fracture groups. The dissemination of the doctrine of "splinting them where they lie" must be accomplished by the regional groups. The greatest problem we have to face is the jack-knifing of long bones after fractures during their transportation to hospitals. First aid in automobile accidents on highways often does more damage than the original injury. The patient is bundled into an automobile without adequate splintage. It has been definitely shown that a lateral splint does not prevent overriding. The average citizen does not get as good treatment as did the doughboy in a shell-infested battlefield overseas. If a soldier can apply traction in "No-Man's-Land," certainly a fireman, mortician, or state policeman could do so in peaceful surroundings.

The regional groups are best fitted to instruct the public in the use of immediate traction for fracture of the extremities. At the present time there are many industrial centers of population throughout the

United States where there are no regional groups. If we are to protect our traveling public properly we must have groups arranged on geographical principles. This does not necessarily mean state lines.

The establishment of the present regional groups was largely accomplished by personal visits of Dr. Scudder. In selecting new members for the Committee on Fractures it will be advisable under this plan to select them from geographical locations throughout the country. In this manner a member of the general committee could be assigned certain geographical groups that he should oversee and whose work he should co-ordinate with that of the other localities through the Committee on Fractures.

Dr. Gordon, of my own clinic at the Fifth Avenue Hospital, has been working on a wooden half-ring splint which will cost less than $2.00 and which is of very light weight. Such a splint could be carried as the equipment of a motorcycle policeman and could be readily mailed back to the original source by parcel post. If some such plan can be established the problem of the expense and bulk will be overcome.

Through the efforts of this Committee the American Red Cross has installed in its latest manual the emergency treatment of traction in the handling of fractures. The American Railway Association has co-operated with your Committee to a very great extent in this same movement.

STANDARD FOR MINIMUM EQUIPMENT FOR FRACTURE TREATMENT IN HOSPITALS

1. That all general hospitals be equipped to care for fractures; that the minimum equipment for the transportation and emergency treatment of fractures be the following or its equivalent:

Thomas upper extremity splints; Thomas lower extremity splints with traction straps, slings and buckle straps; Hodgen splints; coaptation splints, assorted sizes; Cabot wire splints; straight pieces of wood (of assorted length, width and thickness) for splints; plaster of Paris bandages; some form of overhead frame for suspension; suitable X-ray apparatus, including a portable machine, if practicable.

2. That it is highly desirable that one individual surgeon be responsible for the supervision of the care of fractures in each hospital service.

3. That special record sheets be used for fracture cases.

4. That a close follow-up be maintained on all fracture cases for such time as necessary to establish an accurate knowledge of end results.

The personnel of the Committee on Fractures is as follows:

Frederic W. Bancroft, New York, Chairman
Robert H. Kennedy, New York, Secretary
Peter A. Bendixen, Davenport
Willis C. Campbell, Memphis
Isidore Cohn, New Orleans
H. Earle Conwell, Birmingham
Salvador Cordoba, Venezuela
Frederic J. Cotton, Boston
William R. Cubbins, Chicago
William Darrach, New York
Frank D. Dickson, Kansas City, Mo.
Eldridge L. Eliason, Philadelphia
William L. Estes, Jr., Bethlehem
W. Edward Gallie, Toronto
Fraser B. Gurd, Montreal
Donald Guthrie, Sayre
George W. Hawley, Bridgeport
Melvin Henderson, Rochester, Minn.
William L. Keller, Washington
Norman T. Kirk, Washington
Philip H. Kreuscher, Chicago
Samuel L. Ledbetter, Jr., Birmingham
Walter Estell Lee, Philadelphia
George A. Leland, Jr., Boston
Paul B. Magnuson, Chicago
Henry C. Marble, Boston
Clay Ray Murray, New York
Lloyd Noland, Birmingham
Hubley R. Owen, Philadelphia
Dallas B. Phemister, Chicago
Edwin W. Ryerson, Chicago
Charles L. Scudder, Boston
W. O'Neill Sherman, Pittsburgh
Ernst A. Sommer, Portland
Kellogg Speed, Chicago
Frederick J. Tees, Montreal
Jorge del Toro, Porto Rico
J. Huber Wagner, Pittsburgh
John B. Walker, New York
Roscoe C. Webb, Minneapolis
George E. Wilson, Toronto
John C. Wilson, Los Angeles
Philip D. Wilson, Boston

BOARD ON INDUSTRIAL MEDICINE AND TRAUMATIC SURGERY

FREDERIC A. BESLEY M.D., WAUKEGAN, ILLINOIS, Chairman

IN submitting this report upon the work of the Board on Industrial Medicine and Traumatic Surgery for the past year, may we preface it by saying that it is easily understandable that the economic difficulties of both large and small industries were such during this period that it required more intense and persistent effort to elicit their interest in better medical service.

The policy of surveying the industrial clinics of the country was continued, Dr. Williamson and Dr. Newquist working in the field. They have maintained their enthusiasm in their endeavor to stimulate and inspire interest in, and to promote our educational program among the leaders in industry.

The number of industrial clinics which have been visited since the survey began is 975 and of this number 518 have been approved.

There is a growing accumulation of evidence which indicates that employers do not comprehend the importance of the care of their employees. They do not seem to understand how much more efficient and effective a worker is if he is well and strong. They do not appreciate the financial gain that would accrue to them if their human machinery could be kept fit.

This is cited to demonstrate the necessity of maintaining our broad educational program, if the men and women working in industry are to receive better care and more thoughtful consideration.

The program of the Board on Industrial Medicine and Traumatic Surgery, held last year in St. Louis, elicited a great deal of interest and advanced our knowledge of the whole subject. The discussions this year will be very largely upon scientific subjects.

During the past few months compensation insurance companies again have been advancing a policy to secure cheap medical and surgical service. In Illinois they are demanding that a fee of $2.00 be charged for first aid and $1.00 for subsequent dressings. Dressings and other expenses for the doctor are increasing. These companies are taking advantage of the desperate financial conditions existing among physicians and surgeons throughout the country. Organized medicine must take cognizance of this unfair and ill advised policy and protest.

In June following the passing of the National Industrial Recovery Act, the idea was conceived that possibly the results of the investigation by this Board of industrial clinics might be utilized in promoting better care for the sick and injured and thus conserve the health welfare of the workers.

Dr. Franklin H. Martin and I went to Washington and had a very satisfactory conference with General Hugh Johnson and his deputy, Mr. W. L. Allen. Their interest was aroused and we feel sure that ultimately there will be an opportunity to cooperate with the National Recovery Administration in getting a code written that will at least urge industry to do more for the health of its workers. A close contact has been maintained through Dr. Newquist with the National Recovery Administration at Washington.

MINIMUM STANDARD

1. That the industry shall have an organized medical department, or service, with competent medical staff including consultants and adequate emergency dispensary and hospital facilities and personnel to assure efficient care of the ill and injured.

2. That membership on the medical staff shall be restricted to physicians and surgeons who are (a) graduates of scientific medicine holding the degree of Doctor of Medicine, in good standing and licensed to practice in their respective states or provinces; (b) competent in the field of industrial medicine and traumatic surgery; (c) worthy in character and in matters of professional ethics, that in the latter connection, the practice of the division of fees under any guise whatsoever be prohibited.

3. That there shall be a system of accurate and complete records filed in an accessible manner—a complete record being one which includes identification data; cause of illness or injury; nature and extent of illness or injury; detailed description of physical findings; special examinations such as consultations, clinical, laboratory, and X-ray; tentative or provisional diagnosis; treatment; prognosis with estimated period of disability; progress of illness or injury; final diagnosis; condition on discharge; end results; and such additional information as may be required by statute for Workmen's Compensation claims or for other purposes.

4. That all patients requiring hospitalization shall be sent to institutions approved by the American College of Surgeons.

5. That the medical department shall have general supervision over the sanitation of the plant and the health of all employees.

Frederic A. Besley, Chairman
Bowman C. Crowell, Secretary
John E. Bacon, Miami, Arizona
James F. Churchill, San Diego
Samuel R. Cunningham, Oklahoma City
Donald Guthrie, Sayre
Lucian H. Landry, New Orleans
A. D. Lazenby, Baltimore
Charles F. Martin, Montreal
Charles H. Mayo, Rochester, Minn.
Thomas G. Orr, Kansas City
W. O'Neill Sherman, Pittsburgh
Loyal A. Shoudy, Bethlehem
Ernst A. Sommer, Portland
Frederick J. Tees, Montreal
John B. Walker, New York
S. Marx White, Minneapolis

List of Approved Medical Services in Industry

The first list of approved medical services in industry follows. This approval is granted on the basis of compliance with the Minimum Standard for Industrial Medicine and Traumatic Surgery of the American College of Surgeons. There are other industries whose medical services meet the requirements of this Minimum Standard but of which time has not yet permitted a survey. The asterisk (*) indicates Provisional Approval or that the medical services so designated have accepted the minimum requirements of the College standard and are endeavoring to carry them out but for lack of time or other acceptable reasons have not been able to do so in every detail.

Alabama

Birmingham
- Alabama Power Company
- American Cast Iron Pipe Company
- *Stockham Pipe & Fittings Company
- Tennessee Coal, Iron & Railroad Company

Gadsden
- Goodyear Tire & Rubber Company
- *Gulf States Steel Company

Mobile
- Alabama Dry Dock & Shipbuilding Company
- Southern Kraft Corporation
- *Todd Shipbuilding & Dry Dock Company

Woodward
- Woodward Iron Company

Arizona

Inspiration
- Inspiration Consolidated Copper Company

Miami
- Miami Copper Company

California

Crockett
- California & Hawaiian Sugar Refining Corporation, Ltd.

Culver City
- *Metro-Goldwyn-Mayer Studios

Emeryville
- Paraffine Companies, Inc.

Long Beach
- *Ford Motor Company

Los Angeles
- Firestone Tire & Rubber Company of California
- *Fox Film Corporation
- General Petroleum Corporation of California
- Goodyear Tire & Rubber Company of California
- Pacific Electric Railway Company
- Pacific Goodrich Rubber Company
- Paramount Publix Corporation
- R. K. O. Studios, Inc.
- Southern Pacific Company
- Standard Oil Company of California
- *United Artists Studio Corporation

Oakland
- Fisher Body Corporation
- *Montgomery Ward & Company

San Bernardino
- Atchison, Topeka & Santa Fe Railway

San Francisco
- *Emporium, The
- Market Street Railway
- Pacific Telephone & Telegraph Company
- Southern Pacific Company
- Standard Oil Company of California

Santa Monica
- Douglas Aircraft Company, Inc.

Universal City
- *Universal Pictures Corporation

Colorado

Denver
- Colorado & Southern Railway Company
- Denver & Rio Grande Western Railroad
- Denver Tramway Corporation
- *Ford Motor Company
- Gates Rubber Company
- Public Service Company of Colorado
- Union Pacific System

Pueblo
- Colorado Fuel & Iron Company

Connecticut

Bridgeport
- *Bassick Company
- Bridgeport Brass Company
- General Electric Company
- Remington Arms Company
- Singer Manufacturing Company
- Stanley Works

Bristol
- New Departure Manufacturing Company

Hartford
- Colts Patent Fire Arms Manufacturing Company

New Britain
- Stanley Works

New Haven
- *National Folding Box Company
- Sargent & Company
- Seamless Rubber Company
- Winchester Repeating Arms Company

South Manchester
- Cheney Brothers

South Norwalk
- *Hat Corporation of America

Stamford
- Yale & Towne Manufacturing Company

Thompsonville
- Bigelow Sanford Carpet Company

Waterbury
- Scovill Manufacturing Company
- Waterbury Clock Company
- The American Brass Company
- Chase Brass & Copper Co., Inc.

Delaware

Wilmington
- E. I. duPont de Nemours & Company

Florida

Jacksonville
- Ford Motor Company

Tampa
- *Dixie Packing Corporation

*Provisionally approved.

GEORGIA

ATLANTA
Chevrolet Motor Company
*Exposition Cotton Mills

ILLINOIS

CHICAGO
Armour & Company
Automatic Electric Company, Inc.
By-Products Coke Corporation
Chicago, Burlington & Quincy Railroad Company
Chicago Rapid Transit Company
Chicago, Rock Island & Pacific Railroad Company
Commonwealth Edison Company
Crane Company
Grunow Corporation
Illinois Central Railroad Company
Illinois Steel Company
International Harvester Company
Pullman Car and Manufacturing Corporation
Pullman Company
Sears, Roebuck & Company
Standard Oil Company (Indiana)
Swift & Company
Western Electric Company
*Wilson & Company

MOLINE
Deere & Company

PEORIA
Caterpillar Tractor Company

ROCKFORD
Ingersoll Milling Machine Company

ROCK ISLAND
International Harvester Company
*Rock Island Sash & Door Company
*Servus Rubber Company

INDIANA

ANDERSON
Delco-Remy Corporation

CONNERSVILLE
*Auburn Automobile Company

EAST CHICAGO
Inland Steel Company
Youngstown Sheet & Tube Company

FORT WAYNE
General Electric Company
International Harvester Company

GARY
Illinois Steel Company
Universal Atlas Cement Company

INDIANAPOLIS
Eli Lilly & Company
Link Belt Company
National Malleable & Steel Castings Company
Prest-O-Lite Company, Inc.
Real Silk Hosiery Mills

MISHAWAKA
Mishawaka Rubber & Woolen Manufacturing Company

MUNCIE
Ball Brothers Company
Delco-Remy Corporation
Warner Gear Company

SOUTH BEND
Studebaker Corporation

WHITING
Standard Oil Company (Indiana)

*Provisionally approved.

IOWA

BURLINGTON
Chicago, Burlington & Quincy Railroad Shops

CEDAR RAPIDS
Quaker Oats Company
T. M. Sinclair & Company, Ltd. (Wilson & Company)

DES MOINES
Iowa Packing Company
Northwestern Bell Telephone Company

FORT MADISON
Atchison, Topeka & Santa Fe Railway Shops

MASON CITY
Jacob E. Decker & Son

OTTUMWA
*John Morrell & Company

SIOUX CITY
Armour & Company
Cudahy Packing Company
Swift & Company

KANSAS

KANSAS CITY
Procter & Gamble Company
Wilson & Company
*Swift & Company

KENTUCKY

NEWPORT
Newport Rolling Mill Company

LOUISIANA

BOGALUSA
Great Southern Lumber Company (and Bogalusa Paper Company)

NEW ORLEANS
American Sugar Refining Company
Holmes, D. H. Company, Ltd.
New Orleans Public Service, Inc.

MAINE

BIDDEFORD
Saco-Lowell Shops
*Pepperell Manufacturing Company
*York Manufacturing Company

CUMBERLAND MILLS
*S. D. Warren & Company

LEWISTON
Androscoggin Mills
*Bates Manufacturing Company
Lewiston Bleachery & Dye Works

RUMFORD
Continental Paper & Bag Corporation
Oxford Paper Company

SANFORD
*Goodall Worsted Company
Sanford Mills

WATERVILLE
Hollingsworth & Whitney Company

MARYLAND

BALTIMORE
American Sugar Refining Company
*Crosse & Blackwell
Crown Cork & Seal Company, Inc.

SPARROWS POINT
Bethlehem Steel Company

MASSACHUSETTS

BEVERLY
United Shoe Machinery Corporation

BOSTON
Boston Elevated Railway Company
Edison Electric Illuminating Company
New England Telephone & Telegraph Company
United Fruit Company—Revere Sugar Refinery

CAMBRIDGE
*Boston Woven Hose & Rubber Company
*Lever Brothers

CLINTON
Bigelow Sanford Carpet Company

EAST WALPOLE
Bird & Son

FALL RIVER
American Printing Company

FRAMINGHAM
Dennison Manufacturing Company

HOLYOKE
American Writing Paper Co., Inc.
Farr-Alpaca Company
National Blank Book Company
William Skinner & Sons

LAWRENCE
*American Woolen Company
Arlington Mills
Pacific Mills

LEOMINSTER
DuPont Visculoid Company

LOWELL
Merrimack Manufacturing Company

LYNN
General Electric Company

MALDEN
Converse Rubber Company

NEW BEDFORD
*National Silk Spinning Company
*Wamsutta Mills

NORTH PLYMOUTH
*Plymouth Cordage Company

PITTSFIELD
*General Electric Company

QUINCY
Bethlehem Shipbuilding Corporation

SALEM
*Naumkeag Steam Cotton Company

SOUTH BOSTON
American Sugar Refining Company

SOUTHBRIDGE
American Optical Company

SPRINGFIELD
*Fiberloid Corporation
*Ludlow Manufacturing Associates
Moore Drop Forging Company
Spalding, A. G. & Bros. Company
United American Bosch Corporation
Westinghouse Electric Company

WALPOLE
The Kendall Company (Lewis Mfg. Co. Division)

WATERTOWN
Hood Rubber Company

WORCESTER
American Steel & Wire Company
Crompton & Knowles Loom Works
Graton & Knight Company
Norton Company
Whittall, M. J. Associates, Ltd.
Wickwire Spencer Steel Company

*Provisionally approved.

MICHIGAN

DETROIT
Chrysler Corporation
Dodge Plant
*East Jefferson Plant
Ford Motor Company
Packard Motor Car Company
Parke, Davis & Company

GRAND RAPIDS
American Seating Company

LANSING
Olds Motor Works
*Reo Motor Car Company

PARCHMENT
*Kalamazoo Vegetable Parchment Company

PONTIAC
Oakland Motor Car Company
Wilson Foundry & Machine Company

MISSOURI

KANSAS CITY
Kansas City Power & Light Company
Loose Wiles Biscuit Company
Sears, Roebuck & Company
Southwestern Bell Telephone Company

ST. LOUIS
Anheuser-Busch, Inc.
*Century Electric Company
Chevrolet Motor Company
Fisher Body—St. Louis Company
Ford Motor Company
International Shoe Company
Mallinckrodt Chemical Works
Monsanto Chemical Works
Southwestern Bell Telephone Company
Stix, Baer & Fuller Company

NEBRASKA

OMAHA
Union Pacific Railroad Company

SOUTH OMAHA
Armour & Company
Swift & Company

NEW HAMPSHIRE

DOVER
Pacific Mills

MANCHESTER
International Shoe Company

NEW JERSEY

ARLINGTON
Dupont Visculoid Company

BAYONNE
Standard Oil Company of New Jersey

BAYWAY
Standard Oil Company of New Jersey

CAMDEN
Campbell Soup Company
Evans, J. R. & Company
R. C. A. Victor Company, Inc.

ELIZABETH
Singer Manufacturing Company

KEARNY
Western Electric Company

NEWARK
Bamberger, L. & Company
Clark Thread Company
New Jersey Bell Telephone Company
PAULSBORO
Vacuum Oil Company
PERTH AMBOY
*Rariton Copper Works
ROEBLING
John A. Roebling & Sons Company
TRENTON
John A. Roebling & Sons Company

NEW YORK

ALBANY
A. P. W. Paper Company
New York Power & Light Corporation
AMSTERDAM
Bigelow-Sanford Carpet Company, Inc.
Mohawk Carpet Mills, Inc.
AUBURN
International Harvester Company
BINGHAMTON
Agfa Ansco Corporation
BROOKLYN
Brooklyn Manhattan Transit Corporation
New York Telephone Company
Squibb, E. R. & Sons
BUFFALO
Buffalo Forge Company
Chevrolet Motor Company
Dold Packing Company
Dunlop Tire & Rubber Company
DuPont Rayon Company
Fisher Body Company
Ford Motor Company
Larkin Company, Inc.
New York Telephone Company
Pierce Arrow Motor Car Company
Pillsbury Flour Mills
Republic Steel Corporation
The American Brass Company
Washburn Crosby Company, Inc.
Worthington Pump Company
CORNING
Corning Glass Works
CORTLAND
*Wickwire Brothers
ELMIRA
Willys-Morrow Company
ENDICOTT
Endicott Johnson Corporation
International Business Machines Corporation
JAMESTOWN
Art Metal Construction Company
LACKAWANNA
Bethlehem Steel Company
MARINERS HARBOR, S. I.
Procter & Gamble Company
NEW YORK
American Telephone & Telegraph Company
*Bankers Trust Company
Bell Telephone Laboratories
Consolidated Gas Company
Federal Reserve Bank of New York
Interborough Rapid Transit Company
International Paper Company
International Telephone & Telegraph Company
Macy, R. H. and Company, Inc.
Morgan, J. P. & Company
National Biscuit Company
National City Bank of New York
New York Central Railroad Company
New York Edison Company
New York Life Insurance Company
New York Stock Exchange
New York Telephone Company
New York Times
*Southern Pacific Steamship Lines
Standard Oil Company of New Jersey
United Dry Docks, Inc.
Fletcher Plant
Morse Plant
United Fruit Company
Wanamaker, John & Company
NIAGARA FALLS
American Cyanamide Company
Carborundum Company
Defiance Paper Company
National Carbon Company
Niagara Falls Power Company
Shredded Wheat Company
Union Carbon & Carbide Company
RENSSELAER
General Aniline Works, Inc.
Kenwood Mills
ROCHESTER
American Laundry Machine Company
Bausch & Lomb Optical Company
Delco Appliance Corporation
Eastman Kodak Company
*General Railway Signal Company, Inc.
Ritter Dental Manufacturing Company, Inc.
Stromberg-Carlson Telephone Manufacturing Company
Taylor Instrument Companies
ROME
General Cable Company
Revere Copper & Brass, Incorporated
SCHENECTADY
American Locomotive Company
General Electric Company
SOLVAY
Solvay Process Company
SYRACUSE
Brown-Lipe-Chapin Company
Crouse-Hinds Company
Halcomb Steel Company
United States Hoffman Machinery Company
TROY
Cluett, Peabody & Co., Inc.
UTICA
*Skenandoa Rayon Corporation
YONKERS
Otis Elevator Company

OHIO

AKRON
Firestone Tire & Rubber Company
Goodrich, B. F., Company
Goodyear Tire & Rubber Company
CINCINNATI
Cincinnati & Suburban Bell Telephone Company
Cincinnati Milling Machine Company
Container Corporation of America
Procter & Gamble Company
Worthington Pump & Machinery Corporation

*Provisionally approved.

CLEVELAND
Cleveland Electric Illuminating Company
Cleveland Street Railway Company
Corrigan McKinney Steel Company
Fisher Body Company
General Electric Company
Halle and Company
National Acme Company
National Carbon Company
National Malleable & Steel Castings Company
Perfection Stove Company
Republic Steel Corporation
Standard Oil Company of Ohio
United States Aluminum Company
White Motor Company
White Sewing Machine Corporation
*Willard Storage Battery Company

COLUMBUS
Buckeye Steel Castings Company
Federal Glass Company
Jeffrey Manufacturing Company

DAYTON
Delco Products Corporation
Frigidaire Corporation
National Cash Register Company

HAMILTON
Champion Coated Paper Company
Ford Motor Company

MIDDLETOWN
American Rolling Mills

NORWOOD
United States Playing Card Company

TOLEDO
Chevrolet Motor Ohio Company
Interlake Iron Corporation
Libby-Owens-Ford Glass Company
Spicer Manufacturing Company
Toledo Edison Company

YOUNGSTOWN
Carnegie Steel Company
General Fireproofing Company
Republic Rubber Company
Republic Steel Corporation
*Sharon Steel Hoop Company
Truscon Steel Company
Youngstown Sheet & Tube Company

OKLAHOMA

OKLAHOMA CITY
Ford Motor Company
*Wilson & Company, Inc., of Oklahoma

TULSA
Mid-Continent Petroleum Corporation

OREGON

PORTLAND
Pacific Northwest Public Service Company

PENNSYLVANIA

ALIQUIPPA
Jones & Laughlin Steel Corporation

ALLENTOWN
Lehigh Portland Cement Company
Fogelsville Plant
Ormrod Plant

AMBRIDGE
American Bridge Company
Byers, A. M. Company
*National Electric Products Corporation

BETHLEHEM
Bethlehem Steel Company

BLOOMSBURG
*The Magee Carpet Company

BRACKENRIDGE
Allegheny Steel Company

BURNHAM
Standard Steel Works Company

BUTLER
American Rolling Mill

CHESTER
Aberfoyle Manufacturing Company
Ford Motor Company

COATSVILLE
Bethlehem Steel Company
Lukens Steel Company

CREIGHTON
Pittsburgh Plate Glass Company

EAST LIBERTY
National Biscuit Company

EASTON
*Individual Drinking Cup Company, Inc.

EAST PITTSBURGH
Westinghouse Electric & Manufacturing Company

EDDYSTONE
*Baldwin Locomotive Works

ERIE
General Electric Company
Hammermill Paper Company

ETNA
Spang, Chalfant & Company, Inc.

FORD CITY
*Pittsburgh Plate Glass Company

HARRISBURG
Pennsylvania Railroad Company

HERSHEY
*Hershey Chocolate Corporation

JOHNSTOWN
Bethlehem Mines Corporation
Bethlehem Steel Company

KINGSTON
*General Cigar Company

LANCASTER
Armstrong Cork Company

LEBANON
Bethlehem Steel Company

LEETSDALE
McClintic-Marshall Corporation

MARCUS HOOK
Sun Oil Company
Viscose Company

MCKEESPORT
McKeesport Tin Plate Company
National Tube Company

MEADVILLE
*Hookless Fastener Company
Viscose Company

MIDLAND
Pittsburgh Crucible Steel Company

MUSE
National Mining Company

NEW KENSINGTON
United States Aluminum Company

PENCOYD
American Bridge Company

*Provisionally approved.

PHILADELPHIA
Abbotts Dairies, Inc.
Atwater Kent Manufacturing Company
Bayuk Cigars, Inc.
Bell Telephone Company of Pennsylvania
Brill, J. G. Company
Budd, Ed. G., Mfg. Co.
Collins & Aikman Corporation
Curtis Publishing Company
Disston, Henry & Sons, Inc.
E. I. duPont de Nemours & Company and Grasselli Chemical Company
*Evening Bulletin
General Electric Company
Gimbel Brothers
Horn & Hardart Baking Company
Link-Belt Company
National Biscuit Company
Pennsylvania Railroad Company
*Pennsylvania Sugar Company
Philadelphia Rapid Transit Company
Reading Company
Sharp & Dohme
Stetson, John B. Company
Surpass Leather Company
Wanamaker, John
Whitman, Stephen F. & Son, Inc.

PITTSBURGH
Bell Telephone Company of Pennsylvania
Byers, A. M. Company
Carnegie Steel Company
Edgar Thompson Works
Homestead Works
Heinz, H. J. Company
Jones & Laughlin Steel Corporation
Pennsylvania Railroad Company
Philadelphia Company and Subsidiary Companies
Pittsburgh Coal Company of Pennsylvania
Montour Mine No. 10
*Pittsburgh Screw & Bolt Company
Pittsburgh Steel Company
Allenport Plant
Monessen Plant

RANKIN
McClintic-Marshall Corporation

READING
Reading Iron Company

SAYRE
Lehigh Valley Railroad Company

SCRANTON
Glen Alden Coal Company
Hudson Coal Company
Pittston Company

SHARON
National Malleable & Steel Castings Company
Sharon Steel Hoop Company

STEELTON
Bethlehem Steel Company

SWISSVALE
Union Switch & Signal Company

VANDERGRIFT
*American Sheet & Tin Plate Company

WILKES-BARRE
Lehigh Valley Coal Company

WILLIAMSPORT
Lycoming Manufacturing Company

WILMERDING
Westinghouse Air Brake Company

WYOMISSING
Textile Industries of Wyomissing

YORK
York Ice Machinery Corporation

RHODE ISLAND

PAWTUCKET
Coats, J. & P. (R. I.,) Inc.
Lorraine Manufacturing Company

PROVIDENCE
*Brown & Sharpe Manufacturing Company
Builders' Iron Foundry
Davol Rubber Company
Gorham Manufacturing Company
National India Rubber Company
United States Finishing Company
Wanskuck Manufacturing Company

SAYLESVILLE
Sayles Finishing Plants, Inc.

TEXAS

BAYTOWN
Humble Oil & Refining Company

DALLAS
*Ford Motor Company

FORT WORTH
Armour & Company
Swift & Company

HOUSTON
Houston Lighting & Power Company
Humble Oil & Refining Company
Sinclair Refining Company
Texas and New Orleans Railroad Company

UTAH

SALT LAKE CITY
American Smelting & Refining Company
U. S. Smelting, Refining and Mining Company
Utah Copper Company

VERMONT

RUTLAND
Rutland Railroad Company

ST. JOHNSBURY
E. & T. Fairbanks & Company

WINOOSKI
*American Woolen Company

VIRGINIA

NEWPORT NEWS
Newport News Shipbuilding & Dry Dock Company

WASHINGTON

SEATTLE
Ford Motor Company
Frederick & Nelson

WEST VIRGINIA

BELLE
*E. I. duPont de Nemours & Company

BLUEFIELD
Norfolk & Western Railway Company

CHARLESTON
Libby-Owens-Ford Glass Company

CLARKSBURG
Weirton Steel Company

GARY
United States Coal & Coke Company

HUNTINGTON
Chesapeake & Ohio Railway Company
International Nickel Company

*Provisionally approved.

MARTINSBURG
*Interwoven Mills, Inc.
PARKERSBURG
Viscose Company
SOUTH CHARLESTON
Carbide & Carbon Chemicals Corporation
WEIRTON
Weirton Steel Company
WILLIAMSON
*Norfolk & Western Railway Company

WISCONSIN

BELOIT
Fairbanks, Morse & Company
KENOSHA
Nash Motors Company
KOHLER
Kohler Company
MILWAUKEE
A. O. Smith Corporation
*Bucyrus Erie Company
Cudahy Brothers Company
Cutler-Hammer Company
Globe Union Manufacturing Company
International Harvester Company
*Plankinton Packing Company
RACINE
J. I. Case Company

*Provisionally approved.

COMMITTEE ON UNDERGRADUATE, GRADUATE AND POSTGRADUATE TEACHING OF SURGERY AND THE SURGICAL SPECIALTIES

THE personnel of the Committee is as follows: Fred C. Zapffe, Chicago, chairman; Elliott C. Cutler, Boston; Irving S. Cutter, Chicago; George J. Heuer, New York; Alexander R. Munroe, Edmonton; Allen O. Whipple, New York.

Dr. Fred C. Zapffe, Chairman, presented to the Board of Regents the following résumé of the findings of the Committee:

Undergraduate teaching. 1. The important surgical subjects to teach the undergraduate medical student are: surgical diagnosis, principles of surgery, and the care of trauma and sepsis.

2. Order in which these topics are taught: second year, principles of surgery and minor surgery; third year, surgical diagnosis and surgical pathology, by lectures, clinics, and dispensary; fourth year, clinical clerkships in the hospital.

3. More time should be given in the second year for the teaching of principles of surgery and technical methods.

4. Opinions are unanimous that practical operative surgery should not be taught to undergraduates.

5. The subject most poorly taught is anæsthesia.

Graduate teaching. The opportunities for graduate instruction in surgery are inadequate. The concensus of opinion is to increase the period of graduate instruction. The majority of teachers favor the medical degree, plus one year of interneship as the requirement for admission to graduate study.

There is no indication that the form of instruction should be altered. That is also true of the scope of instruction. A period of four years is favored by the majority of teachers. In the main, the time should be devoted to the acquisition of a larger clinical experience, to laboratory work, and to a large operative experience.

Surgical teachers experienced in this field conclude that the resident or fellowship type of instruction, including residence in a teaching hospital, is the most promising form of surgical education.

In addition to general surgery, a surgical education should include a knowledge of the specialties of urology, orthopedics, and gynecology.

Postgraduate teaching. Postgraduate teaching in surgery should be limited to candidates who have had adequate graduate courses in surgery in teaching covering a period of from three to five years, or who have had adequate surgical interneship, followed by a period of active surgical work in practice.

Licensure of surgeon and specialist. Men doing major surgery or practicing one of the surgical specialties should have special training for such work. The use of the term "specialist" should apply only to those men who have had special training beyond what is required for the medical degree and who are limiting their practice to a special field. Certain countries have undertaken the issuing of specialist certificates. Other countries have passed legislation similar to that passed in Alberta, Canada, in 1926.

It seems necessary to have legislation in this country because:

1. The term specialist must be defined and its use restricted by law.

2. Boards should be established with authority to issue certificates to those qualified to receive them. Any legal regulation will be enforced more successfully if the duty of enforcement is undertaken by one of the national medical bodies.

3. Uniformity between requirements of various boards in every state and province is essential.

The Committee was thanked for its work and the report was received for further consideration by the Regents.

MEDICAL MOTION PICTURE FILMS

J. BENTLEY SQUIER, M.D., NEW YORK, Chairman

THE importance of motion pictures as a means of disseminating medical knowledge has been generally accepted by the profession, and there is an ever increasing interest in the work of the American College of Surgeons in co-operation with the Motion Picture Producers and Distributors of America, Inc. Films produced under this arrangement are of unusual significance as examples of the possibilities of this method as an aid in the teaching of medicine and surgery.

The College is very glad to receive for review any medical motion picture film. Many have already been sent in, and a card catalog is being compiled as the films are reviewed, with the idea of securing detailed data concerning all available medical and surgical films. This will enable us to supply information as to what films are available on any special subject, where they can be obtained, and whether or not they are satisfactory for the purpose desired.

During the past several years improvements have been made in recording methods and in projection equipment that will be important factors in the application of talking films to the teaching of medicine and surgery. The Board on Medical Motion Picture Films is keenly interested in the development of this type of films and is maintaining close contact with the various organizations concerned with this phase of motion picture production and distribution.

Very large audiences were present at all times at the continuous daily exhibition of medical motion pictures. The 71 films used for these demonstrations included several new talking films with both sound-on-film and disc recording, and also colored motion picture films.

Thirty-three reels of medical motion picture films have been approved by the American College of Surgeons and are available for distribution. Many additional films have been reviewed by the College, and though they have not yet been formally approved, our reviewing committees consider them to be an effective presentation of the subject matter, and the procedures shown to be of interest and value.

Information pertaining to medical motion picture films may be obtained by communicating with the College.

The Board on Medical Motion Picture Films of the College consists of the following members:

Will H. Hays, Esq., New York, Honorary President
J. Bentley Squier, New York, Chairman
Philemon E. Truesdale, Fall River, Secretary
W. W. Chipman, Montreal
George W. Crile, Cleveland
Bowman C. Crowell, Chicago
Malcolm T. MacEachern, Chicago
Franklin H. Martin, Chicago
Charles H. Mayo, Rochester

STATE AND PROVINCIAL SECTIONAL MEETINGS

IN the early part of 1933, plans were formulated for the following series of sectional meetings to be held during the course of the year:

Arizona, New Mexico—Phoenix, March 26–27;
California, Nevada—Los Angeles, April 2–3;
Washington, Oregon, British Columbia—Montana, Spokane, April 9–10;
Utah, Colorado, Idaho, Wyoming—Salt Lake City, April 16–17.

Unexpected circumstances prevailing in the early part of 1933 made it advisable to cancel these meetings, but success in carrying through the plans for the same series in 1934 is assured.

The sectional meeting has been compared to a Clinical Congress in the scope of its activities, and every effort is made by the College to include in a sectional meeting program as distinguished a group of visiting speakers as are invited to an annual Congress. Important factors in the choice of a city for a sectional meeting are its clinical facilities and its accessibility from the standpoint of travel. Another important factor in assuring the success of these meetings is co-operation on the part of the local Fellows in the carrying out of the plans for the meeting, arrangement of clinics, and participation in the scientific program. Of the 165 successful sectional meetings held by the College since 1920, every one has had back of it the interest and co-operation of the local Fellows to whom much credit is due.

An interesting feature of the program of the sectional meeting is the showing of medical motion pictures, sound and silent, covering a wide range of surgical subjects. Hospital standardization conferences, also of inestimable value to surgeons as well as to hospital personnel, are held in conjunction with the meetings.

The education of the laity in matters pertaining to health, disease, scientific medicine, and hospitals constitutes one of the major activities during all meetings. Several agencies are employed for this purpose. The lay press is furnished with numerous articles on scientific medicine, prior to and during the meeting and with numerous interviews by visiting speakers during their sojourn in the city in which the meeting is held. Health talks are given to the children through the courtesy of the departments of

education. Numerous health talks are broadcast over the radio, and a community health meeting is held in each city. At these meetings the visiting speakers present their subjects to audiences numbering from two to five thousand. The speakers appear before service clubs and chambers of commerce, also.

Thus the American College of Surgeons delivers its message, not only to the surgeon but to the layman as well.

THE CREDENTIALS COMMITTEES AND COMMITTEE ON HISTORY REVIEWS

THE procedure of admitting candidates to Fellowship in the American College of Surgeons requires that each candidate, after filing his application, be recommended by his State or Provincial Credentials Committee before proceeding further with his papers. In each State and Province there is a Credentials Committee composed of from fifteen to thirty-five members who are Fellows of the College, elected to serve on the Committee by the Fellows of the College of their respective State or Province for a term of two years, one-half of the Committee being retired each year.

No candidate is admitted to Fellowship without the recommendation of his State or Provincial Credentials Committee.

The members of these committees give generously of their time and meet at a designated city in their State or Province at least once a year and review the credentials of all candidates whose applications are on file from their respective State or Province. Much credit is due these committees for their part in the work of the selection of the men who comprise our Fellowship.

After a candidate for Fellowship has been recommended by the Credentials Committee of his State or Province, he is required to submit one hundred clinical records to the College, fifty in complete detail of major work done by himself and for which he is the responsible surgeon and fifty in abstract of major work at which he has assisted or which he has done himself. These records are carefully examined by the Committee on History Reviews composed of outstanding surgeons in the fields of the surgical specialties from the four leading medical universities in Chicago.

This year 626 sets of histories were received and of that number 609 sets or 60,900 individual histories were examined in detail by the Committee on History Reviews. The remaining 17 sets were not reviewed as the applicants had not yet received the approval of their State or Provincial Credentials Committees. Of those reviewed, 543 sets were accepted and 66 sets were not accepted. Those whose histories were not accepted have the privilege of later submitting additional histories.

Fifteen meetings were held by the Committee on History Reviews for the purpose of studying histories and during the four weeks preceding this meeting many additional hours were spent by the members of this committee in order that every candidate's records received this year might be reviewed.

The records, half of which were histories of cases of major operations performed by the candidates and the other half abstracts of cases which they had operated upon themselves or at which they had assisted, were checked with the utmost care, particularly with respect to the preoperative data indicating the thoroughness with which the case was studied, the technique, and the end results.

The histories which were recognized as being of unusual merit were segregated and were the subject of a special review of the committee as a whole for the selection of those which were considered from the standpoint of completeness, accuracy, and form of presentation to merit special mention.

The members of the Committee on History Reviews who have served this year and to whom the College is greatly indebted for the many hours spent in the laborious work of reviewing the histories submitted are:

James H. Bloomfield
Carl H. Christoph
Dwight Freeman Clark
Harry Culver
William C. Danforth
Frank E. David
Joseph S. Eisenstaedt
Harry Jackson
Oscar H. Kraft
Philip H. Kreuscher
Michael L. Mason
Golder L. McWhorter
George J. Musgrave
Oscar E. Nadeau
Rudolph J. E. Oden
Charles H. Parkes
Charles H. Phifer
Guy S. Van Alstyne
Charles B. Younger

THE LIBRARY AND DEPARTMENT OF LITERARY RESEARCH

THE Library and its allied Department of Literary Research have completed twelve years of service to the Fellows of the College and other members of the medical profession. In this period the College Library has grown from the small but well chosen collection which was the property of the late Dr. John B. Murphy (about 2,200 volumes) to a library of approximately 20,000 volumes with an additional package library composed of about 90,000 pamphlets.

In developing the Library a threefold plan has been followed including: (1) the collection and preservation of writings of historical value, (2) the accumulation of books and treatises of current scientific interest, and (3) the collection and preservation of the writings of the Fellows of the College, a record of the advances of the present age for the use of future generations of surgeons.

That this threefold plan might be fully developed Fellows of the College have been asked to co-operate by presenting copies of their writings—one copy of each book and two of each reprint (one for the Fellow file and one for circulation in the package library collection)—and second, to notify the librarian of any works which may be available for placement, either individual volumes or entire collections. Only with the full co-operation of every Fellow will it be possible for this, your library to benefit from the many contacts afforded through the large and influential membership of the College.

Those in charge of the work wish to express their gratitude to the individuals and clinics who have assisted with this program in the past year, to those who have contributed the many books and reprints which have been placed on the shelves and in the files, works of value for current reference purposes.

In addition to the many smaller gifts, three extensive contributions have been received at the College Library during recent months: the collection of the late William McDowell Mastin, Mobile, Alabama, which includes eighteenth and nineteenth century volumes in French and English, back files of journals, as well as material having current reference value. This was received in August, 1933.

Dr. H. Winnett Orr, of Lincoln, Nebraska, has continued to contribute to the very fine collection of historical works which he is accumulating for the College. His unusual collection of rare old volumes in which the sixteenth, seventeenth, and eighteenth centuries are excellently represented is being augmented by something over a hundred volumes recently acquired.

Finally, the College is happy to announce the gift of the library of the late Dr. Albert J. Ochsner, a founder of the American College of Surgeons, for many years treasurer of the College and in the year 1923–24 its honored president. We are grateful to his family for placing these volumes where he would undoubtedly wish them to be and to his associates at Augustana for their generous co-operation.

The College Library is growing. It has grown and is growing because it is the Library of the American College of Surgeons, a library truly representative of the interests and works of the Fellows as a whole and as individuals; and a library which, uniquely, is available to all Fellows of the College and members of the medical profession whether they be located in Chicago or Australia.

This availability of the Library is a factor dependent upon the services offered by the Department of Literary Research. The department consists of a small group of workers especially equipped to select reprints, compile bibliographies, and prepare abstracts and translations on medical and surgical subjects. If reprints only are desired these can be supplied without charge in package library form; bibliographies, abstracts and translations are furnished at a nominal fee.

During the past year many individual requests for research have been received, some of them being continuous surveys which have carried through the year and have required weekly or monthly reports; some of these pieces of research have required a series of abstracts or complete translations chosen from an extensive bibliography—others careful combing of all available sources for data on subjects upon which very little has been written.

Whatever the need of the individual Fellow—whether a review of the literature including extensive translations from the German, French, Italian, Spanish, Rumanian, or Scandinavian languages, or a simple bibliography compiled from the published indices—we are prepared to care for it efficiently. The Department has a high aim—to bring the literature of the world to the doorstep of every Fellow of the College whatever his need and wherever he may be located, and to do this expeditiously and economically.

CHICAGO COMMITTEE ON ARRANGEMENTS

EXECUTIVE COMMITTEE—Philip H. Kreuscher, Chairman; Oscar E. Nadeau, Secretary; Joseph Beck, William R. Cubbins, Frederick H. Falls, Harry S. Gradle, Carl A. Hedblom, Charles E. Kahlke, Herman L. Kretschmer, Karl A. Meyer, Dallas B. Phemister, Edwin W. Ryerson, Henry Schmitz.

COMMITTEE ON SURGERY OF THE EYE—Harry S. Gradle, Chairman; Thomas D. Allen, E. K. Findlay, Sanford Gifford.

COMMITTEE ON SURGERY OF THE EAR, NOSE AND THROAT—Joseph Beck, Chairman; Austin A. Hayden, Edward P. Norcross, S. J. Pearlman.

COMMITTEE ON COMMUNITY HEALTH MEETING—W. A. Evans, Chairman; Austin A. Hayden, Carl A. Hedblom, Herman L. Kretschmer, Karl A. Meyer, Dallas B. Phemister, Lena K. Sadler.

REPRESENTATIVES OF HOSPITALS AND MEDICAL SCHOOLS—Fred L. Adair, Edmund Andrews, George Apfelbach, Arrie Bamberger, Frank E. Brawley, Paul Brown, Fremont A. Chandler, Leonard Charpier, Eugene J. Chesrow, I. H. Chilcott, Carl H. Christoph, Frederick Christopher, Peter Clark, Irving S. Cutter, D. J. Davis, Harry J. Dooley, W. A. Fisher, M. L. Folk, Thomas C. Galloway, Gatewood, John A. Graham, J. B. Haeberlin, John R. Harger, William T. Harsha, Henry S. Houghton, Ernest E. Irons, Minas Joannides, Harold O. Jones, Henry R. Kenny, Joseph J. Lebowitz, Francis Lederer, John Lindsay, Michael L. Mason, Hugh McKenna, R. W. McNealy, Arthur Metz, W. F. Moncreiff, Beveridge Moore, Louis D. Moorhead, G. Henry Mundt, John B. O'Donoghue, Fred B. Olentine, Daniel Orth, Harry L. Pollock, Charles B. Reed, Emil Ries, John F. Ruzic, Samuel Salinger, Charles F. Sawyer, A. J. Schoenberg, Victor Schrager, George H. Schroeder, George E. Shambaugh, J. H. Skiles, A. E. Stewart, Alfred A. Strauss, George deTarnowsky, J. W. Tope, Guy Van Alstyne, Bertha Van Hoosen, Loren Wilder, Thaddeus Z. Xelowski, Charles B. Younger, A. G. Zimmermann.

OFFICERS ELECTED

President: Robert B. Greenough, Boston.

Vice-Presidents: Charles A. Dukes, Berkeley; Roscoe R. Graham, Toronto.

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HOSPITAL STANDARDIZATION

THE MODERN PHILOSOPHY OF MEDICINE

REV. ALPHONSE M. SCHWITALLA, S.J., PH.D., ST. LOUIS
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IN attempting to carry out the request of the Executive Director of the American College of Surgeons by writing this paper upon so ambitious a title, I can readily reconstruct Hamlet's mental attitude toward Horatio and address the medical profession:

> There are more things in heaven and earth, Horatio,
> Than are dreamt of in your philosophy.

Dr. MacEachern has cast me for the rôle of Hamlet. Just as Hamlet tried to tell Horatio of his thoughts, so our genial but determined Director, has asked me to tell the medical profession what it thinks, what it ought to think and what, to my way of thinking, is the only correct thing to think.

There be philosophies and philosophies. When the Stagirite, walking on the shores of the Ægean, elaborated his thoughts on life suggested to him as they were by the moving of the fiddler-crabs and the crawling of the sea urchins, we speak of his thoughts as the *philosophia perennis*. When the modern salesman talks of the most approved and most recent methods of hawking his wares, he illustrates his own principles by speaking of his dissertation as the philosophy of salesmanship; when the side-show barker scatters innuendoes which effect a psychic exophthalmia in the youth of twenty-three, he boasts of his achievement as based upon the philosophy of sex appeal. And again, a particularly recalcitrant delinquent tells his psychiatrist that he is following out his philosophy of life. It is hard to find in these and in innumerable other designations the common denominator justifying in all of them the common description of being a "philosophy."

What, therefore, do I understand by the modern philosophy of medicine? It might be unnecessary to delimit this thought too rigorously. It would be too confining to erect around this concept eight-foot-high walls of reinforced concrete within which I would force myself to confine my own remarks. Suffice to say for our present purposes, that I wish to comment briefly upon the few mental concepts which might be considered basic in the modern science of medicine and basic too in the practice of the modern art of medicine.

To begin somewhere, we might hark back to those earliest days of systematic thinking when with an insight little short of supreme genius, Aristotle laid it down that any event or fact is intelligible in the light of its four causes—two intrinsic, the material cause and the formal cause; two extrinsic, the instrumental and the final cause. To be sure, the doctrine of causality is not as palatable as it might be to many a modern thinker's palate, but we are not interested here in controversies concerning causality but rather with philosophy. And who will forbid me to think, first of all, of causes when I am asked to speak on a philosophy if I choose with many and many a critic of the past to define philosophy as the science of causes. Assuming then my right to think of philosophy in such terms, I might ask myself, first of all, whether or not modern medicine also can be made intelligible in the light of Aristotle's four causes. The question, if it has no other purpose, will at least serve this useful one of effecting a measure of order in our thought and of preventing too lengthy a dissertation as a perpetration on the patience of this audience.

The material cause of anything is the object, be it a material or a logical object, from which a certain effect evolves. Now medicine, modern medicine as well as ancient medicine, has always been concerned and is now concerned, with human nature. Modern medicine, however, differs from the ancient in this respect that, so we flatter ourselves, human nature means much more to us than it did in the past. We have analyzed the concept of human nature into its component parts to a degree which staggers us by its refinements and its intricacies. And most recently, we have succeeded again in recombining those infinitesimal fragments into a unified and harmonious concept of the organic whole. And in this re-synthesis we have progressively stressed the thought of the particularization of this human being as compared with that. We are constantly learning more and more to lay emphasis upon the one rather than upon the many. The sciences fundamental to medicine are progressively unlocking to us the mysteries of individuality. If in the past we have stressed the likenesses between man and man, today we are stressing more and more the unlikenesses. Today, dissimilarities are found to have their significance rather than similarities, and the significance of general laws vanishes in the more clearly understood importance of the single or even the unique fact. Two or three decades ago, we were quite prepared to interpret heredity in terms of the transmission of unit characters and all characters were thought to be unit characters. Today, we are prone rather, if we have kept step with progress, to stress

the uniqueness in the process of trait-development in each one of us, the modifiability of the general law in each particular case and the complex process of individualization in each one's development. Similarly, in the field of bacteriology, some of us are not too old to recall the hunt for a specific organism for each specific clinical entity. In those days the Bacillus tuberculosis meant tuberculosis and the Bacillus typhosus meant typhoid fever. Today we are not surprised to recognize clinical tuberculosis even in the absence of the Bacillus tuberculosis and surely, we are not looking for a clinical tuberculosis wherever there is the Bacillus tuberculosis. We have learned that what we called a causative organism is truly an organism and also causative, but not always causative of what it is thought to be a cause.

We have amplified the subscience of etiology. Whereas before, it meant the science of specific and particularized causation, today it has come to mean a much-more-embracing and comprehensive study of hereditary and environmental, far remote as well as intimately proximate, prodromes through the synergism of which, obvious effects are produced.

In the face of all of this, let me ask you what should medical practice do? Clearly, medical practice should particularize, it should follow general directions and general trends but always with a clear realization that such guides and trends are but remote approximations to the problem of this individual and that a closer approximation to the truth about this individual can be achieved only by more detailed and painstaking analysis.

To discuss this further would, to be sure, lead us, if we choose, into the most recondite intricacies of medical practice. Let me ask only one question. How can all that I have said be reconciled with the group practice of medicine, whether by group practice we understand the medical care of groups of individuals by one practitioner, or the care of one individual by groups of practitioners, or the care of groups of individuals by groups of practitioners? It has been said with overstatement, it is true, but yet with no little stress upon an objective fact, that each pupil should theoretically study best by having an individual teacher. With almost the same amount of truth, it may be said that each patient should have his own individual doctor. And yet we are inclined to group patients and to group physicians; yet we are counselled to organize our medical efforts; to let them culminate in medical centers; to pyramid the successive efforts of specialists until these reach an apex in diagnosis and therapeutics resulting from the combined conscious effort of the many, each one of whom will study not the individual as a whole, not human nature, but the individual's parts, this system, that organ, this tissue, that lesion. Not in this way lies progress. Analysis is a path to progress; synthesis alone is progress. Science and art must go hand in hand. If art outruns science, we have quackery and charlatanism; if science outruns art, we have inadequacy and unjustifiable conservatism. Only when medical practice attempts at the first safe moment to apply the new findings of library and laboratory, will we give our public that measure of medical attention and service which is commensurate with the onward march of medical thought. And to my way of thinking, the wholesale practice of medicine is opposed fundamentally and completely to the stresses we have learned to lay upon the individual's human nature.

But medicine is engaged not merely with human nature as such, but rather the diseased human being. And so we find the formal cause of medicine to be the temporary or permanent, physical or psychological deficiency of the human being. To be sure, we may argue for hours about the nature of disease; we may invoke whichever definition we please to clarify our logic; we may stress clinical as opposed to laboratory symptomatology; we may confine our thinking to general terms or enumerate an endless series of details; we may look upon disease as a reaction or a disequilibration or as a defective adaptation or as the disintegration of a reaction pattern. All of these definitions are helpful in their place; all can be defended and all can be applied to a more or less limited extent, but whatever we do, it seems to me, we miss one of the most significant features of disease if we restrict our thinking concerning disease too much to the realm of the physical. It has become popular, to be sure, to talk about the psychological concomitants of disease. Why have we neglected to lay stress upon the psychological precursors? It has become popular to lay stress upon the social causative factors—poverty as the cause of malnutrition; inadequate housing as the cause of depressed vitality or contagion; and social strain as the cause of the externalization of a previously latent diathesis. The physician who thinks in modern terms employs all of these concepts in his evaluation of the patient's condition.

Modern medicine has learned to be sympathetic with much of what we have thought discarded in the thinking of the ancients. If humoral medicine is resurrected in hormonal medicine and if phrenological indicia are revived in constitutional indices, then surely we may expect that it is only by touching upon all of the factors which enter into the making of a man that modern medicine can achieve its long sought goal of finding a formula for the comprehensive understanding of disease.

And again, I ask, how can the art of medicine translate such a philosophy into practice? The answer cannot be cramped into a mathematical formula, nor is it for me in this place to apply therapeutics. If I may be permitted a word of criticism, I merely wish to ask how such concepts, true as they undoubtedly are, can be considered compatible with the divided responsibility implied in certain forms of medical practice advocated by those who visualize the practice of medicine rather as an economic than as a scientific and artistic or an altruistic avocation? I can appreciate and get a clear concept of the value of five kilowatt hours of energy, but I can find no standard by which to estimate what is

meant by five minutes or five hours of medical care. I am trying to say that the intangibles of life are incommensurate with the tangibles. Weights and measures are not the only values; dollars not the only standards. The physician, to my way of thinking, who is prepared to put a price upon his services forgets their intrinsic pricelessness and substitutes for the joy of discovery and insight which he should feel in the face of this sick human being, the satisfaction that comes from the crinkling dollar bill or the jangling coin.

The instrumental cause is the medium through the intermediating agency of which an effect is produced. The instrumental cause of medicine is manifold. It consists of physical instruments, apparatus and equipment, glassware and metalware, microscopes, stethoscopes, galvanometers, nephelometers, of cardiographs and kymographs, and other graphs and other meters and other scopes without number. But most of all, it consists of the mental processes of the individual physician who gathers a fragment of truth from each of his instruments and by comparison and judgment, by reasoning and insight, by deduction and induction, by abstraction and concentration, gathers his fragmentary truths into the grand truth of his diagnosis and then translates this emergent of his thinking into the result of his doing by wise and well considered therapeutics. The human mind of the physician is the chief instrument without which all the other instruments that serve the practice of medicine are but so much brass and glass. And the object of the physician's mind that to which he applies this supreme instrument of his practice, is the problem before him. The physician fails who does not see a research problem, a great unknown *X* in each of his patients. In the anatomy and physiology, in the chemistry and psychology of his patients, he searches and researches all the more because modern medicine has pushed the paths of progress farther into the twilight zone of the unknown human and has opened up not merely the super-highways to the land of border knowledge but countless by-paths into the regions of the unexplored. Is it not true that if any patient were studied as modern medicine is today prepared to study him, we should be all brought face to face with the confines of the unknown?

How different all of this sounds from a recent pronouncement that medical practice and particularly some of the more intimate relationships between doctor and patient are susceptible "of completely objective analysis." Is the research process susceptible of completely objective analysis? I know there are those who are prone to lay down formulæ for research, elaborate sets of rules, prescriptions for procedures, methods for tabulations, and short cuts to statistical results, but thank God there is research and research. The processes of the human mind have not yet been expressed as a completely objective analysis. If the science of medicine is expressible in the results of human thinking, certainly the art of medicine is not so expressible and I am convinced that not only thought but emotions and sentiments, character traits as well as mental traits, love of truth as well as truth itself, must all enter into the processes of research if the fullest results are to be had from medicine and its practice.

It may be possible to analyze completely certain forms of research but when the thinker in a moment of exaltation sees a new relationship, when with a vision like that of a poet he penetrates beneath the surface of reality and conjures up from the subconscious a new expression of hidden truth, then, I believe, such processes defy completely objective analysis. The physician who has struggled perhaps for months with a resistant disease, who has exhausted the resources of his mind, of his library and his laboratory, and the mental capacities of his consultants, and then finally, when the moment is darkest perceives the coming of light, that man cannot be convinced that all his work is but the result of tabulation and statistical synthesis.

And at last we come to the final cause of medicine and medical practice—the promotion of human welfare and the preservation and amelioration of human life. In this the physician must find his happiness and content, his reward and his remuneration. To be sure, I would not have the physician seek his food in vague dreams, but neither would I have the physician content himself with the economic results of medicine and medical practice. Medical practice is in its primary and fundamental concept not an economic process. Economic results may be and should be by-products, they cannot be the primary product of medical practice. And the reason for this is briefly this, that no valuation can be attached to human life and human happiness. Dollars and cents are not commensurate with health; contentment, a sense of power, a sense of well-being cannot be expressed in dollars and cents. The modern philosophy of medicine has taught us the value of personal hygiene, of mental hygiene, and social hygiene in the conduct of the world's affairs. Who would attempt to express these values by such crude standards as we use to define the costs of life's commodities? The physician strives to make the world a safer place for man; he is not concerned even with nations or races, with industrial groups or social communities; his work transcends all of these and embraces in its amplitude the whole of mankind, present and to come.

How foreign to such purposes are the details upon which we have recently laid stress. Hospitalization plans and insurance plans and the financial rates for the physician. No, I am not talking here in terms of an exaggerated idealism. I pray and hope that the physician may have his rightful share of the world's goods, a fair return, even a generous return, for his labors and his expenditures. But these again, I like to think of as means to an ulterior end and as means only to enable the physician to carry out still better and better the aims for which he went into medicine. If he entered medicine to become rich, I hope he may fail; if he entered medicine

to bring health and happiness to mankind, I hope he may succeed also in acquiring wealth, at least of a modest and unpretentious dimension. But in our thinking about medicine, let us lay our first stress upon the dignity, the intrinsic value of medicine, and our secondary stress upon medicine's capacity for increasing the practitioner's bank account.

Have I overdrawn the picture? It may be true that sixty per cent of the physician's practice is routine; it may be true that that percentage and perhaps even a higher percentage of the physician's work is expressible in the terms of a simple prescription which any partially trained attendant could write out, but we judge of the dignity of a profession not by its routine work but by the sublimity of the achievements which it is called upon to effect in moments of heroic need. A man's worth is judged by what he does but even more by what he can do. The modern philosophy of medicine shows us that the physician of today is and must be a man whose head rises above the masses; it shows us also however, that if that commanding figure envies the lot of the masses, if he ambitions the satisfactions of the masses and thinks in terms of the values of the masses, he is going to fail in achieving that for which he has been raised above the masses.

REPORT OF THE 1933 CONFERENCE IN CHICAGO

AN abstract of the papers and discussions presented at the sixteenth annual Hospital Standardization Conference held in Chicago, October 9-12, 1933, is found in the following pages. Dr. J. Bentley Squier, New York, past-president of the College, presided.

OPENING ADDRESS

J. BENTLEY SQUIER, M.D., New York: It is well to get together on occasions such as this. It is well for surgeons, physicians, trustees, hospital executives, nurses, and others to discuss mutual problems concerning the care of the patient. Group conferences, lead to group thinking and group action, thus bringing about better co-operation and co-ordination.

I am particularly pleased that the members of medical staffs of hospitals have opportunity to study hospital problems at close range. Since the physician daily spends several hours in the hospital caring for his patients this is good reason why he should be more familiar with its workings and its administrative, social, and economic problems. The governing body and management need his sympathetic advice and aid in improving the institution. The physician himself needs this knowledge better to cooperate with the hospital management in caring for his patients.

I am also firmly convinced that contact of this nature can do much to avoid conflict or controversy of interests in the hospital. Not infrequently do we hear of discord between members of the medical staff and the governing body or management. No institution can make real progress without the utmost harmony and co-operation. And this is as it should be for all groups are bound together by a common interest, that is, the care of the patient. There is also a community of interests—the patient wants to get well; the relatives and friends spend anxious moments with the recovery of the patient uppermost in their minds; the physician uses every possible means of scientific medicine at his disposal in the care of his patient; the entire hospital personnel is helping the physician in his battle against disease; the governing body provides the physical facilities and money to assist the physician and personnel in the work of diagnosing the disease and treating the patient. And finally, the watchful public expects the hospital, with its facilities, its doctors, nurses, technicians, and other aides, to bring the patient back to health in the quickest and most comfortable manner. Thus we find this far reaching community of interests a common basis for our deliberations.

SIXTEENTH ANNUAL REPORT

FRANKLIN H. MARTIN, M.D., Chicago: In presenting my annual report in 1932 before this conference I said in part:

The practitioners of scientific medicine and the hospitals are so closely allied in a partnership that neither could exist without the other. It is necessary that each should be established on the same high ethical basis and protected against the encroachment of irregulars, cultists, charlatans and unscientific practices of whatever kind—or our influence will be dissipated.

In guarding ourselves against the subtle commercialism of some of our confreres the College has found no more dependable protection against fee splitting than the influence of the staffs and superintendents of our approved hospitals. Persistent rumors of fee division emanating from approved hospitals are investigated by the College. If the hospital is indifferent and fails to absolve itself, the institution must be dealt with summarily.

Every hospital, too, must safeguard its medical staff by refusing privileges to irregulars to practice therein. If the institution fails in this protection, the College has no discretion—it must remove the hospital from the approved list.

In regard to the abuse in hospitalization of veterans by the government, it is gratifying to know that effective measures have been instituted to curtail this injustice and that our protests of last year, backed by the medical profession did much to focus attention on this injustice and cause the government to institute a remedy.

Community hospitals must give the highest quality of service to the sick and injured and also care-

fully guard the cost with respect to (a) extravagance in building; (b) inefficiency of service; (c) carelessness in segregating patients according to ability to pay; (d) lack of provision for moderate priced rooms for patients of moderate means; (e) disproportionate diagnostic accessories and possible overcharges; (f) lack of discrimination in applying extras; (g) indiscriminate supplying of food; (h) carelessness in assignment of nurses; (i) operating room extravagance; (j) excessive charges for anæsthetics.

For five years the College has urged the hospitals to co-operate with physicians by offering the services of their institutions for diagnostic purposes; also the College has urged the people to go to their doctors for periodic health examinations and to utilize the diagnostic facilities in approved hospitals as the duplication of equipment by the general practitioner is unnecessary and prohibitive.

Through these means the hospital becomes the meeting ground for the regular practitioners of medicine and a haven for the people of the community. It would solve the problems of all physicians and their patients in the conduct of diagnostic service; it would aid in the establishment of cancer clinics, and in the early diagnosis of preventable diseases.

Now I have the pleasure of presenting to you the annual Hospital Standardization report for 1933:

A SUMMARY OF REPORT—1918-1933

A. Sixteen surveys of hospitals of *100 or more beds:*

1918— 692 hospitals surveyed.
89 hospitals fully and provisionally approved.
12.9 percentage approved.

1933—1,603 hospitals surveyed.
1,505 hospitals fully and provisionally approved.
93.9 percentage approved.

B. Twelve surveys of hospitals *50 to 99 beds*:

1922— 812 hospitals surveyed.
335 hospitals fully and provisionally approved.
41.3 percentage approved.

1933—1,045 hospitals surveyed.
660 hospitals fully and provisionally approved.
63.1 percentage approved.

C. Ten surveys of hospitals of *25 to 49 beds*:

1924— 307 hospitals surveyed.
49 hospitals fully and provisionally approved.
15.9 percentage approved.

1933— 907 hospitals surveyed.
211 hospitals fully and provisionally approved.
23.2 percentage approved.

D. Nine surveys of *Government hospitals* of the United States:

1925— 100 hospitals surveyed.
90 hospitals fully and provisionally approved.
90.0 percentage approved.

1933— 116 hospitals surveyed.
116 hospitals fully and provisionally approved.
100.0 percentage approved.

Total surveyed	3,555
Total fully approved	2,150
Total percentage fully approved	60.4
Total provisionally approved	226
Total percentage provisionally approved	6.4
Total not approved	1,170
Total percentage not approved	33.2
Total fully and provisionally approved	2,376
Total percentage fully and provisionally approved:	
Hospitals—100 beds and over	93.9
Hospitals— 50 beds and over	81.7
Hospitals— 25 beds and over	66.8

THE HOSPITAL STANDARDIZATION MOVEMENT IN RELATION TO THE PRACTICE OF INTERNAL MEDICINE

WALTER L. BIERRING, M.D., Des Moines: It is fitting at this time on behalf of scientific medicine to accord acknowledgment to the American College of Surgeons for its great contribution to the improvement of surgery and the practice of medicine generally through the betterment of hospitals in America.

A classification of hospitals from the viewpoint of the internist has so far not been attempted, although the intimate relation between the practice of internal medicine and that of surgery would make the requirements for hospital standardization generally speaking as applicable to one as to the other.

The standardization program, as instituted by the College and other agencies, has had an important influence in developing the educational function of every modern hospital. The requirements of a fully equipped and efficiently operated clinical laboratory, careful records, a reference library, autopsies, and clinicopathologic conferences are promoting a spirit of study and inquiry among the attending staff that is reflected in a higher type of service in all departments of the hospital.

The modern hospital is an educational factor in the making of better doctors—and these in turn make better hospitals. The two are as necessary to each other and as closely related as the brain or heart is to the body.

The relationship of the hospital to the community has changed. Where once the hospital was but an adjunct, it has become the center, all inclusive, of the medical service of the community. Where once the function of the hospital was largely surgical, it has now been extended to include all branches of medical practice. This enlarged function of the general hospital must necessarily affect all standardization programs.

Recognizing the great service that has been accomplished for the advancement of medical education and medical practice, let us not forget, in

setting up our fixed rules regarding structure, equipment, nursing personnel, and co-ordinated professional activities of knowledge and skill, that it still requires that traditional imponderable something, referred to by Brennemann as the human side of the hospital to accomplish its full measure and scope of useful service.

OPPORTUNITIES OF THE SURGEON AND THE HOSPITAL IN PROMOTING COMMUNITY INTEREST IN THE PROPER CARE OF THE SICK

BERT W. CALDWELL, M.D., Chicago: The interests of the medical profession and of our hospitals are mutual and intimate. The economic security of our institutions is necessary to the material prosperity of the profession, and the lack of it is reflected in the unsatisfactory economic status of the members of hospital staffs and a consequent lowered professional morale. A breakdown in the voluntary hospital system in this country would presage both economic and professional disaster to the surgeon and physician.

The growth of our hospitals from a few hundred at the end of the nineteenth century to almost seven thousand today was not accidental. Their increase in bed capacities and in the departmental services has been in direct response to the requirements of our medical and surgical staffs for the proper treatment of the seven and one-half million patients annually admitted to our hospital wards.

The public has invested in its tax-supported hospitals, which through political agencies of their own choosing the people administer, the sum of $1,416,000,000. The public pays in taxation, for the support of these governmental institutions, in excess of $415,000,000 each year. The growth of bed capacities in governmental institutions in the past 25 years has been three times as great as in voluntary institutions, and expenditures for their support have increased five times as rapidly. Fifty per cent of the service of these hospitals is dedicated to the care of custodial or domiciliary patients.

But the public, the patient and the medical profession, is more concerned with the voluntary hospital, in which the philanthropic people of our communities have invested $1,404,000,000—almost as much as the government has in its tax supported hospitals. In these voluntary hospitals, five and one-half million of the seven and one-half million patients were admitted last year. These hospitals have been built, often endowed, and are almost entirely operated by our churches, by philanthropic and fraternal associations, for the care of the well-to-do, the patient of moderate means, and the unemployed or charity patient, (the government hospital being concerned in the care of the non-pay patient only). These voluntary hospitals are supported mainly by the pay and part pay patient, and by philanthropy.

During the years since 1929, the curve in bed occupancy in the government hospitals traveled steadily upward, while the curve of pay-bed occupancy in voluntary hospitals declined alarmingly as the curve ascended sharply for free beds in the voluntary hospitals. One-third of the work and service of the voluntary hospitals in 1932 was dedicated to the care of the charity patient.

There seems but one reasonable way out of this difficulty, and that is for the government to reimburse the voluntary hospital for at least the cost of the care and service it gives the indigent or unemployed patient. It is difficult to follow the reasoning of the government, when the rule was established that the care of the indigent and unemployed is the responsibility of the government up to the moment that illness or injury made hospitalization necessary, after which the responsibility for the care of the patient, with all its costs, became the responsibility of the hospital and the surgeon, not of the government.

Philanthropic support of hospitals has been reduced from $135,000,000 in 1929-30, to less than $40,000,000 in 1931-32, and this support will be further reduced in 1933.

In spite of the lowering curve of bed occupancy in our voluntary hospitals and with due consideration of the rising curve in tax supported institutions, there is no surplus of hospital facilities as at present set up, in normal times and under normal conditions. A close analysis of the money spent in this country for medical and hospital service, seems to indicate that the total of this money, if spent through proper channels and properly distributed, would be sufficient to take care of the patient, maintain our existing hospitals, and keep the bed occupancy of our voluntary hospitals at satisfactory levels.

The voluntary hospitals have been the bulwark against the intrusion of state medicine, medical socialism, medical quackery, and all of their attendant evils. The income of the surgeon increases as the revenues of the voluntary hospital grow. The voluntary hospital is not now, nor ever can be, a commercial enterprise. Every dollar it receives must be put back in the care of the patient or in the betterment of plant and equipment. It is a public welfare agency and an educational institution of decided merit, giving one-third of its service to the frankly charity patient and to the part-pay patient. In taking over this added burden of the care of these patients, the voluntary hospitals are making an important contribution to national recovery and are doing their full share in forwarding the success of the administration program, but nine out of ten of them are incurring serious operating deficits and the remainder are using their endowments to prevent deficits.

If you would help your institution in the best way and at the time it is most needed, build up the community confidence in its work, help to conserve its resources, strengthen its morale, maintain its ethics unimpaired, and upon this firm foundation, your hospital will be secure, and the permanency of its acceptable care of the sick and injured of the community will be assured.

PREPARATION FOR A SURGICAL CAREER

WILLIAM D. HAGGARD, M.D., Nashville: During the past forty years medical knowledge and surgical achievements have made rapid strides and have kept pace with the other fields of scientific investigation and results. The only constant thing in this world is change. The ideals of the profession and the responsibility of the profession as well as the responsibility of the surgeon are constantly changing. The training for a surgical career and the preparation of the individual surgeon is a matter that the test of time determines.

Forty years ago, two years in medical college with or without one or two years of hospital experience consituted the training received by the best surgeons. Many successful surgeons were largely self-taught and most had an apprenticeship under a practicing surgeon. However since then such a large mass of scientific material and such intimate knowledge of many fields of surgery has been developed, that it is practically impossible now for any one man to master the enlarged field of surgery in so casual a way. It is important, however, to train for general surgery before becoming a specialist.

What should the preparation for a surgical career embrace? The making of the surgeon has many phases: (a) the background of birth and home training, and primary, secondary, and collegiate education is important; (b) specific medical undergraduate education, terminating in the hospital and laboratory training which constitutes the foundation of surgical education; (c) special hospital internship and residency; (d) a longer period of special training for surgery. The collegiate period is as follows: (a) the premedical training; (b) the medical course; (c) the internship; (d) the residency; (e) the laboratory and assistantship; (f) the clinical training.

The premedical college training should include arts and sciences with special emphasis on sociology and economics and science of chemistry and biology. This can be combined with the medical training in a class "A" medical school and both degrees can be taken in six years or, better still, by using the four quarter system, completed two or three years earlier.

The medical school should begin the clinical work early in the third year and some contact with patients should be had in the first and second years. If this is done the medical student will learn the correlation of the basic sciences as applied to the patient.

After graduation, should come the internship of one or two years in an approved general hospital so that experience will be obtained on a rotating service, making the training broad. The clinical staff and attending staff have great responsibility for training and education during the preclinical period and clinical period. Clinical training should encourage observation, accuracy, professional honesty, and economy, as well as manual dexterity. The ideals of the American College of Surgeons for the junior candidate, and finally fellowship in the College, should be the goal of every young surgeon.

There are three main roads of education that may lead to a surgical career after the internship:

1. General practice for three to five years, followed by one year's post-graduate surgical study with a review of surgery, both laboratory and clinical, and one year's extramural residency under a surgeon approved by the university. Such a course is offered by some of our better medical schools. General practice of medicine with a gradual limitation to the field of surgery has the disadvantage that the surgeon is largely self-taught.

2. After the internship a three years' training in clinical work, surgery, laboratory investigations, animal experimentation, postmortem work or pathology, including one year as assistant in the operating room. Such a fellowship is found in some of the larger clinics. This gives a well rounded training both in scientific investigation and in how things should best be done. The defect is that actual operating experience is limited. This may be remedied by association with an established surgeon in private practice.

3. A residency in surgery after a general hospital service in a university or other hospital for two to five years, combined with some teaching. While this method cannot be enjoyed by every aspirant, it is at present the most satisfactory preparation for a surgical career.

Finally, to the young surgeon, friendship in books should be kept warm—medical journals will stimulate the scientific spirit; the personal contact and regular attendance at medical societies is invaluable, and lastly, travel to the various clinics here and abroad adds enjoyment, confidence, culture, and inspiration to the young surgeon.

A CENTURY OF PROGRESS

EBEN J. CAREY, M.D., Milwaukee, Wisconsin: For the first time in the history of international expositions in America, organized medicine, dentistry and pharmacy are presenting to the public the story of their contributions to the progress of civilization.

The objectives of the exhibits on health education by visual and auditory methods are: (1) to compare health conditions of a hundred years ago with those of today; (2) to instruct the public in the intricacy of the living human machine and to give warning not to meddle with it by dangerous self-medication; (3) to interest the layman in the scientific story behind the physician's services and opinions regarding health and sickness; (4) to show that compassion for suffering humanity, and not commercialism, ruled the lives of the great discoverers and practitioners of medicine.

The co-operation of medical institutions in the United States, Canada, and Europe has been beyond expectation. The scientific medical institutions of England, France, Germany, and Italy, responded in a gratifying manner by installing exhibits related to epoch making scientific advancements. The medical industries of the United States have undertaken more than a mere display of products, they have

portrayed stories of the scientific advancement of medicine.

THE NEXT CENTURY OF PROGRESS IN MEDICINE

GEORGE W. CRILE, M.D., Cleveland, Ohio: During the past 100 years the average span of life has lengthened from less than 40 years to more than 58 years. This has been due largely to the conquering by medical science of the diseases which gave rise in the past to epidemics which ravished the race. Plagues have disappeared, and the diseases which once caused epidemics occur now only in isolated instances. The hazards of childbirth have been reduced and artificial feeding for infants improved to the extent that the human race now comes into the world, passes through infancy, childhood, and early adult life in relative safety.

What may we expect to happen during the next 100 years? The rôle of the physician will have changed to such an extent that his profession will seem an entirely new one as compared to the practice of medicine today. This change will be brought about by education through the schools and the intelligent public to the extent that the people will be as well informed on general medical lines, diet, hygiene, and preventive measures as the physician of today. The chief duty of the physician of the future will be to develop the race, direct the development of the young, and guide the adult along the lines of safety and health. The physician will be more concerned with prevention of disease than with its treatment. Group medicine will have become definitely established and the specialties in medicine advanced to higher degree. Surgery will continue to make advances but its field will grow narrower as preventive medicine advances; the field of the internist will be widened particularly in his knowledge of ductless glands and psychology, while biophysics will be an important factor in the advancement of therapeutics.

The solution of the individual problems which we are now trying to solve will have met with varying degrees of success. Tuberculosis and diabetes will have been conquered, diseases caused by focal infections will be reduced, while the incidence of these diseases effected by the kinetic drive of environmental conditions may even be increased. Preventive measures will reduce the incidence of goiter to the minimum; advances will have been made in prevention of gall stones and ulcers of the stomach, while venereal diseases will be reduced greatly because they will be openly controlled. The hazard of childbirth will be further reduced but congenital deformities will occur with the same frequency. The span of life will be lengthened still further, but the nature of cancer, although revealed, will claim many victims.

In the field of nervous and mental diseases we shall still be "in red ink." The complicated mechanism of the web of life in which civilized man is enmeshed will lay a heavy toll on the brain and nervous system and ductless glands and in consequence on the heart, blood vessels, and kidneys. However, the physician will impart to his patient the knowledge of the far reaching effects of protracted emotional strain, of overwork, and of worry, and will be able to raise the threshold to the damaging activating stimuli which have produced the evil results.

Within certain limits, the physician of the future will be able to control the growth of body and the development of the mind. He will acquire such a knowledge of biochemical and biophysical processes that he will be able to guide his fellow men as an engineer of living processes.

HOSPITAL STANDARDIZATION FROM THE STANDPOINT OF THE INTERNIST

S. MARX WHITE, M.D., Minneapolis, Minnesota: In the search for broader and more effective applications of our service, the control must rest wholly with physicians and the individuals or groups to whom the service is rendered, and not with any non-medical group, such as corporations for profit, insurance companies, or hospitals.

The focal point for consideration is not the surgeon nor the medical man—it is the patient. We call patients collectively the public. Too large a portion of the public seeks the services of scientific medicine as a last resort, only to have the physician sign the death certificate after the charlatan or the cultist has done his work. Knowing that more than one-third of our population is incapable of sound and considered judgment, we have been inclined to be contemptuous of public opinion and to look upon the fault as the public's and not our own. With this attitude I agree in part, but we should attempt to correct the misunderstandings apparently inherent in public opinion. Although the saving of life is reflected in vital statistics, where he who runs may read, and reduction in morbidity is equally well authenticated, the spectacle of the individual unable or unwilling to submit himself to considered medical and surgical judgment is altogether too frequent today.

In my view a prime need in the reorganization now well under way in medical and surgical service, is improvement in the mechanisms for coordination between the various fields. Our organization does not as yet lend itself to free and full enough interchange of work and opinion. Too often the medical man seems to wish to treat all conditions with the mechanisms of his specialty. Too often the surgeon seems to want to treat all conditions by his special means. Much mutual misunderstanding, destructive alike to our common interest and to public opinion of our profession, is engendered.

I can speak from actual experience with three forms of group coordination: (1) in a teaching hospital, under the auspices of a state university, where advancement of knowledge is the primary purpose and care of the patient, while unexcelled in technical details, is impersonal; (2) on the staff of private general hospitals, where cordial co-operation is a

recurring delight—but the hospital cannot reach out into the home and the practitioner's consulting room, where most decisions concerning procedures are made; and (3) in a group clinic, which lends itself to free, full, and ready interchange of information and experiences.

In a properly constituted group clinic, each patient has his own physician—the one he has selected, or to whom he has been directed because of his presenting complaint; this physician is in charge of the entire investigation and responsible for its management. The broadening effect of group effort is well recognized by those using it; furthermore, the patient can see that no interest save his own enters into the conduct of his case. The very fact that there has been full and free consultation by the different men involved goes far to reassure him. Much of value to us and—of more importance—to the public, may be brought about by more effective grouping and organization.

Your organization has already made a great beginning along many of these lines. Your credit for this is already secure. I venture to suggest that properly invited and encouraged by you, the American College of Physicians and other correlative organizations could do much to further the interests you have already assumed, and to place medicine and surgery and the hospital in still better position for service.

MAINTAINING AS LOW HOSPITAL CHARGES AS ARE CONSISTENT WITH GOOD CARE OF THE PATIENT, FROM THE STANDPOINT OF THE SURGEON

A. W. Blain, M.D., Detroit: The surgeon would be the last to advocate a reduction in hospital standards or to suggest inadequate care for his hospital patients; his success and reputation depend to too great an extent on good hospital care. But no surgeon,unless he has a financial interest in the hospital, is particularly happy to see the hospital make unnecessary inroads into the patient's bankroll—especially when the patient ordinarily discharges his financial obligation to the hospital before he does to the surgeon.

As a good business man, therefore, the surgeon is going to favor elimination of frills and superfluities. For example, most patients experience an undeniable thrill over the thought of social entertainment during their hospital stay, and obligate themselves for extra expense which they can ill afford to pay. If this feature could be eliminated, hospital bills could be greatly reduced and the patient's physical welfare promoted.

Many patients are over treated and are harmed thereby. The surgeon can protect the patient's financial welfare and also his own by eliminating excessive treatment. Much of postoperative hospitalization is doubtless overdone; and pre-operative hospitalization is probably excessive in many cases also, as for thyroidectomy—in which the pre-operative preparation can often be done as well at home.

People have been educated to expensive tastes which are very much out of order today. The doctor must help re-establish medical and hospital care on a sensible and conservative basis, at a cost which the patient can pay. The surgeon wants his patients to receive adequate scientific care; but he also desires the elimination of frills which are not only costly to his patients, and indirectly to himself, but which are injurious and detrimental to his patients' physical welfare.

MAINTAINING AS LOW HOSPITAL CHARGES AS ARE CONSISTENT WITH GOOD CARE OF THE PATIENT FROM THE STANDPOINT OF THE RADIOLOGIST

H. B. Podlasky, M.D., Milwaukee, Wisconsin: The radiologist must be considered as a member of the medical profession and not as a technical appendage. If the medical profession accepts the fact that, with the changing times, it becomes necessary to revise our method of charging or to make a radical change in the general care of those who seek our services, then it must be accepted that the radiologist must take his place in the ranks of adjustment. It is not fair to assume, however, that high surgical fees should be maintained and the complementary, or so called corroborative work, be obtained as cheaply as possible.

When and if the time comes that services of all physicians will be standardized, it will be fair to assume that the present system of fixed charges obtaining in many hospital X-ray departments is a just and equitable arrangement. As things stand today, such a practice is pernicious and detrimental to the morale and future development of any radiologist who finds himself subject to such regulations as the only means of gaining a livelihood.

HOSPITAL ECONOMIES AS APPLIED TO THE SMALL HOSPITAL

Clinton Smith, Waterloo, Iowa: In studying the present problem of economies in the small hospital, we have three suggestions to offer:

I. *In every small hospital the following general program of economy is applicable:* (1) the selection of an efficient personnel; (2) an enthusiastic economy program—to detect the leaks and stop the waste; (3) careful planning of building and placing of equipment; (4) intelligent purchasing, supported by a systematic, perpetual inventory; (5) a systematic accounting of all expenditures, including that for insurance (which, owing to the drop in real estate values, should be brought under a reduced schedule); (6) a credit system which brings about prompt payment of hospital bills.

II. *Survey of 26 hospitals of 50 to 200 bed capacity.* We have recently conducted a survey of 26 hospitals, asking for a list of the economies introduced in their institutions during the past year. We herewith present a condensed report of this survey: (1) cutting salaries from 10 per cent to 45 per cent of the entire hospital staff; (2) limiting vacations with pay: nurses, 2 weeks, employees 1

week; some hospitals gave vacations without pay; (3) closing schools of nursing, placing student nurses in larger schools, and employing graduate nurses to take their places; (4) increasing responsibility, with more tasks given to one person and dismissal of unnecessary help; (5) careful purchasing; (6) caring for own rooms by nurses during week, with maid service on Saturday; (7) refusing to buy equipment to satisfy the whim of some staff member; (8) operating the laundry a half day or every other day; (9) charging flat rates for tonsillectomies, obstetrical cases, routine laboratory, and decreased rate for X-ray (in some institutions, discount is given for the cash payment of the hospital bill when the patient leaves); (10) having superintendent of nurses do general floor duty work; (11) using nurses about to graduate in various positions and keeping them for a year of post-graduate work at a small salary; (12) practicing economy in all possible small ways—attention to lights, water, steam, garbage, linen, laundry, all surgical and medical supplies; maintaining large gardens and using persons who owe hospital bills to care for the gardens; canning and preserving fruit and food stuffs; taking as payment poultry, eggs, fruit, vegetables, sausage, etc.

III. *Suggested plans:* (1) The merging of hospitals where similar management, purpose, and methods prevail would be an economy measure. Under one management, more efficient service could be given the patient. (2) The appointment of director of laboratories for two or more hospitals. If the director is both a roentgenologist and pathologist, his services can be obtained at reasonable cost, and, with a competent technician in each laboratory, a great saving can be gained. (3) The establishment of the same schedule of salaries and rates among local hospitals which will eliminate hospital "shopping." (4) The maintenance of the same courtesy schedule by all local hospitals, to apply to physicians and their families, ministers and their families, war veterans, etc. (5) The use of the same system of extending credits which will have the effect of making the community plan for its hospital bills as it plans for gas for its automobiles. (6) Co-operative purchasing by local hospitals.

In the survey of these 26 institutions, it was discovered that efficiency was not sacrificed. The patient received scientific, sympathetic nursing and medical care.

Two major problems should receive immediate attention: *Publicity*—to keep the hospital and its service before the community; and *group hospitalization* or *group insurance*—to prepare the public for the emergency of illness, and to bring increased patronage to the small hospital.

THE ESSENTIAL PRINCIPLES OF THE GROUP PURCHASE OF HOSPITAL SERVICE

WILLIAM H. WALSH, M.D., Chicago: The purpose of this paper is to present a clear cut statement of the principles involved in group payment plans for hospital service, the essentials of an acceptable plan, and the dangers of those schemes which are unsound. The evidence of the need for some method whereby the people of moderate means can meet the unexpected and often overwhelming cost of hospital service has been ably presented elsewhere.

Definition. A group payment plan for hospital service is a method whereby a hospital or hospitals unite in an agreement with groups of employed individuals for the purpose of providing, at a minimum cost, hospital service of a stated nature and duration, if and when needed, to those individuals who subscribe to the agreement. The objective is to reduce the individual cost of hospital service to those requiring it by spreading the expense over a group of sufficient size, the individuals of which pay an annual subscription, to assure a fund adequate to meet predetermined hospitalization demands.

The agreement is made directly between the hospitals and the individuals, the hospitals themselves setting up such additional business machinery as may be required; there should be no profit to anyone and the activity should be strictly of a co-operative nature. It differs from insurance in that in return for the subscription the hospitals agree to render a service in the event of a contingency, but in no event does there enter the element of pecuniary indemnity.

Legal aspect. On the basis of questionnaires addressed to all the state insurance departments, it is evident that in a great many states the statutes and judicial decisions are such as to preclude the operation of such group plans without complying with the insurance laws. It would, therefore, seem desirable for those interested in the furtherance of group hospital service to secure the enactment of enabling legislation which will not only permit non-profit group hospitalization plans to operate outside the insurance regulations, but will also so regulate their organization and operation as to place them beyond the reach of commercial exploitation.

Essentials of equitable plan. That an equitable, sound, feasible, and entirely ethical method for spreading the cost of hospital service can be formulated is beyond question; and the following fundamental factors must be observed if this movement is to be universally successful: (1) unified action by all the hospitals in a community, in order to avoid undesirable competition; (2) non-commercial administration, probably by an executive council of trustees from affiliated hospitals (formation of a separate corporation as previously advocated by the writer is now believed to present legal complications and should be avoided); (3) reasonably accurate actuarial calculations, and a wide enough spread of the group subscriptions so that excessive morbidity in any one group will not destroy the reserves; (4) competent legal approval of the plan; (5) reserve fund, accumulated by properly adjusting the annual subscription rate, *per caput diem* payment to hospitals, estimated percentage of beneficiaries, anticipated number of days of bed occupancy, and administration and organization expenses—the fund to be

invested according to the savings bank statute; (6) publicity and propaganda, to be controlled by the affiliated hospitals and subject to the approval of the local medical society; (7) cost of securing the original enrollments, including the engaging of promotional experts, to be borne by the affiliated institutions; (8) ward type of accommodation, with the privilege of more privacy if paid for; (9) extent and limitation of hospital service should be clearly stipulated; (10) cash reimbursement, of the annual payment when prolonged public disaster makes group hospitalization impossible; (11) enrollment of about 1,500 is the minimum for assuring fairly accurate average calculations; (12) professional ethics, standards and prerogatives to govern all details of the plan; (13) medical attendance to be specifically excluded from the plan, and to be arranged between subscriber and physician; (14) subscribers to be admitted to hospital only upon their physician's recommendation, and to have free choice of both physician and hospital; (15) qualifications of staff specialists to be certified by the hospital.

Combined hospital and medical service. That this combination is advantageous to the medical profession, the subscribers and the hospitals has been well demonstrated in various parts of the country. It is always for the medical group concerned to decide whether or not medical attendance is to become a part of the plan, and if so, to formulate an equitable fee schedule.

Estimates as to the cost of complete hospital service and medical attendance to groups, vary from twenty to forty dollars per individual per year. We have sufficient evidence at hand to indicate that hospital service alone can be furnished to groups at a cost not exceeding twelve dollars per year per individual, and it is believed that adequate medical attendance can be furnished also by doubling this sum, or for twenty-four dollars per year. Neither the hospital nor the attending physicians have to concern themselves with the collection of the fees since the hospital renders the physicians' accounts to the Fund at the same time as the hospital accounts, and payment is made directly to the physician. Compensation and all other conditions should be such as to assure good medical service.

The agreement between the physicians and the hospital group should in all details be in accord with sound public policy and the code of ethics of the American Medical Association.

If all of these factors are thoroughly understood, there is no reason why this activity cannot be established in every community where a sufficient enrollment is possible and where there are no legal obstacles, thereby meeting a pressing need of the wage earner and supporting the local hospitals.

A practical application of the group payment plan has already been worked out, on the basis of twelve dollars per individual per year for an enrollment of 4,000 in a community of 32,000 population with two hospitals.

ALAMEDA COUNTY PLAN

C. A. Dukes, M.D., Oakland, California: Alameda county has a population of about 500,000. The County Medical Society has a membership of 500. About July, 1917, the board of supervisors, at the suggestion of the County Medical Society and lay organizations, appointed an institutions commission composed of lay and medical members to administer the funds and the institutions devoted to the care of the indigent. So well has this been done that there has been no complaint or any attempt to return these activities to political control. The commission has in its charge, through a medical director, Dr. B. W. Black, the county hospitals, county health department and physicians, indigent clinics, and also the tuberculosis sanitarium and a preventorium for children located in a delightfully warm spot in our foothills.

Some monies from the tax fund had been provided for clinics and hospitals not under the control of the medical director, but in August, 1932, because of the depression, these funds were abruptly cut off. The County Medical Society with the co-operation of Dr. Black then worked out a plan whereby people who are not indigents but have very meager resources could have adequate medical attention at rates based on their ability to pay. The organized medical group is in control of all medical activities to the advantage of patient and physician. Personal choice of physician is maintained, and the society is charged with the responsibility for proper care and charges. The provision for proper hospitalization has been difficult, and the medical society is now working on a plan for periodic payment of hospital care.

In all of these plans, the co-operation of the hospitals, nurses, dentists, and other auxiliary medical services, has been very encouraging.

THE APPLICATION OF HOSPITAL STANDARDIZATION IN SMALL HOSPITALS

Marsh T. Lewis, Princeton, Indiana: All I know of hospitals I learned as chairman of the board of a small hospital of 35 beds, in the city of Princeton, Indiana. But I would like to impress on the management of small hospitals the fact that it is possible for a small hospital to meet the standardization requirements without any great expenditure of money; that the organization is not political and you do not have to have all the members of your medical staff Fellows of the College to have your institution recognized; that if any member of your medical staff is qualified he does not have to have inside influence to be accepted as a Fellow; that there is nothing you can do that will improve the work of your operating force and medical staff and create more public interest in your institution than to plan, start, and carry out your campaign for a certificate of approval. Keep your public informed as to what you are doing to raise the standards of your hospital.

The knowledge and ability of any member of the staff is at the service of all in the care of patients in

our institution. Jealousies and pettiness among individual members are not tolerated by our staff. At the present time there is not a doctor in our county who is not bringing his hospital cases to our institution. We had during the year 1932 in our little 35 bed hospital, 418 operations performed, as well as medical and obstetrical cases. We are going through the depression without any debt whatever, and are paying cash for all improvements.

THE ANNUAL HOSPITAL REPORT

CHARLES E. REMY, M.D., Minneapolis: Certainly the average individual will glean more from a few simple statements of facts *in words* than he could derive from volumes of facts expressed only in columns of figures. Why is it, therefore, that the average annual hospital report consists, for the most part, of compilations of page upon page of figures? I wonder how many superintendents attempt to read or take the time to analyze such a report when it comes to their desk. I must admit that I have neither the time nor inclination to decipher them. There are more than enough statistical tables and columns of figures in connection with my own institution which it is necessary at least partially to digest. Yet I can always find the time not alone to read, but thoroughly to enjoy and derive inspiration from such reports as those published by the Rockefeller Foundation and an occasional hospital wherein the material consists of simple statements and discussion of facts, interspersed with only an occasional statistical table.

Even the published books on hospital administration, with a few exceptions, confine themselves to compilations of figures and cost accounting. There is more to hospital administration and sound hospital practice than statistics and cost accounting. There are laundry, engineering, architectural, social problems, and many others which cannot be compressed into a page of statistics. Even the medical care of the patients themselves might be of some interest, although it would appear from most published annual reports that hospitals are only concerned with patients as regards their numbers and the financial return derived from them.

Thus, in the compilation of our annual reports, we at the Minneapolis General Hospital have diverged from the beaten path. We have exposed to the gaze of the critic all our weaknesses, all our mistakes, all the major problems which beset us during the period covered by the report. Many errors and discrepancies will undoubtedly be discovered in our statistics, methods, programs, and policies. If we have made grievous mistakes, then others may perchance avoid similar pitfalls by viewing the error of our ways. If we have made any advancement in policies or technique, or discovered short cuts to any goal, then other hospitals may possibly utilize these to the advantage of the hospital field as a whole.

Our annual report has automatically separated itself into three divisions: (1) administrative report, containing the didactic report of the superintendent, general statistical and financial reports, any and all special reports which may have been prepared during the year for the hospital governing board, and full presentations of all new policies, procedures, or regulations which may have been evolved during the year. (2) Reports of the hospital administrative divisions, containing discussions by the directors of those departments, accompanied by such statistical and financial tables as they believe essential to the proper rounding out of their reports. (3) Reports of the hospital professional divisions—medical, surgical, obstetrical, and other divisions—as presented by the various chiefs of staff; they embrace a discussion of the work accomplished in each department during the year and such supportive statistics as may be deemed essential.

I am convinced that if all hospitals would publish annually reports wherein were discussed in detail the various problems encountered during the year and in which the policies and practices of the institutions were set forth, many defects would the sooner be eliminated from hospital practice and administration.

THE ADVANTAGES OF STANDARDIZED READY MADE DRESSINGS

D. B. DANN, Flint, Michigan: In 1927 and 1928, a study of dressings was made by a committee of the American College of Surgeons. This study revealed that "approximately five thousand different types of dressings are in use among hospitals of the United States and that as many as fifteen hundred varieties of one type are employed for practically the same purpose." The committee recommended standard dressings, 22 in number, of stated size and construction. While the study was of a general character and did not attempt to cover the special fields, it was a great step forward in the field of standardization, and it has been proved in the last 4 years that the standardizing of dressings is not only possible but is of advantage to the surgeon and all others interested. To accomplish the desired results, however, the idea must be generally accepted.

It is an assured fact that hospitals themselves, and not the manufacturers, are best fitted to assume and should take the responsibility and initiative of developing a group of dressings which will be satisfactory to the surgeon and meet the economic problems of the hospital. In our effort at the Hurley Hospital, Flint, Michigan, to standardize dressings we found that the abdominal pad of the 10 by 8 dimensions was too bulky in most instances. Upon experimenting with different sizes, our doctors and surgical supervisors decided on the size 8 by 5. This was large enough to absorb the drainage in the average case and to cover the wounds after the majority of operations. When this idea was generally accepted, we found that we were able to show a saving, over a one-year period, of $1,201.60, or $100 a month, on this one item alone. And the change has been approved by the surgeons.

The establishment of a uniform standard for dressings will be of great advantage in the nursing field, since it will then be possible to teach a standard of dressing technique which will be applicable in every institution. A nurse would then know definitely, no matter in what hospital she worked, how to use the dressings given her, and her work would thus be more successful and less costly. Moreover it is an assured fact that manufacturers, with their machinery and mass production, can make standard dressings more economically than can hospitals with hand labor.

The committee on the standardization of dressings knows that some of the accepted items may be improved upon, and will therefore at times send out questionnaires so that they may have the criticism and opinions of the Fellows, and make changes if it is found necessary.

It has been suggested that the dressings for the special fields be studied, and, if possible, a standard arrived at.

CONVALESCENT CARE FOR THE PATIENT

G. Harvey Agnew, M.D., Toronto, Ontario: We are realizing more and more that the patient still needs supervision and care long after his stitches are out and his hospital record neatly filed away. Definite physiological changes—metabolic, cardiovascular, endocrine—persist for weeks after the acute stage is over, as well as mental and emotional shock. Asthmatic, orthopedic, pediatric, and mildly psychotic patients all require special convalescent care. And the value of convalescent accommodation to the community cannot be too strongly emphasized: earlier return to work, lower incidence of relapses, and lessened community relief outlay. Many hospitals are being forced to enlarge public ward accommodation, although they might not be overcrowded were the non-acute cases housed elsewhere.

With a total of approximately one million hospital beds in the United States and Canada, we have but some 179 convalescent institutions with 8,747 beds. Twenty-four of the states and 4 of the provinces have no convalescent facilities. Furthermore, if our lists were limited only to those convalescent homes which are properly equipped and staffed to handle the various types of patients needing this care, we would find very few communities, indeed, with adequate accommodation.

As an example of the extent to which convalescent care has been developed elsewhere, there is the Astley Ainslie Institution in Edinburgh, the convalescent unit of the Royal Infirmary. This institution is unusually well equipped with laboratories; X-ray, electro- and hydrotherapy; dental and other facilities. Fully 50 per cent are bed patients; they are often sent here 4 days after operation. This fully endowed 150 bed unit has proved of great assistance in relieving the wards of the overcrowded parent hospital.

Every convalescent unit should have a sufficient and qualified nursing staff so that all of the nursing is not left to poorly trained attendants. It is not always feasible to employ physiotherapists, dietitians, occupational therapists, recreational supervisors, and others, desirable as such personnel would be, but capable and versatile nurses and attendants, co-operating with a part time medical staff can accomplish wonders in these various activities. There seems to be a general realization that the handling of the patient is of far more importance than the erection of fine buildings; for this reason it is well to create maintenance endowments or subsidies and not put all assets into brick and mortar.

Hospital care of convalescents costs less than that of acutely ill patients; how much less depends to a large extent upon the service provided. The *per diem* cost in most of our better convalescent units ranges well up to the two dollar mark, frequently higher, and those institutions which keep their costs down to "a dollar or so" can provide but minimum attention to more or less self-sufficient patients. And the substitution for these patients in the general hospital of an equal number of acute patients will increase the *per diem* cost of the general hospital. From a maintenance cost viewpoint, the cheapest location would be a convalescent annex to the general hospital utilizing the same dietary, nursing, purchasing, administrative, and other facilities.

It would seem advisable, and should eliminate duplication, were all general hospitals in a community to unite in directing the local convalescent unit or units. The financial support should be a combination of philanthropy and municipal effort—the department of health, the community chest, and voluntary social agencies co-operating. The general hospitals themselves—medical staffs, administrators, trustees—must take the lead in promoting the development of convalescent hospitals.

ORGANIZATION AND MANAGEMENT OF A DEPARTMENT OF ANÆSTHESIA IN A 200 TO 400 BED HOSPITAL

B. C. Leech, M.D., Regina, Saskatchewan: The observations here presented are based upon experiences gained in 4 years of operating an organized anæsthetic department in a hospital of 410 beds, 160 of which are definitely surgical beds. A well organized department of anæsthesia should be an important component of any hospital of over 200 beds.

The anæsthetic staff should consist of a director who is a qualified and licensed doctor, and is a perennial member of the standing surgical committee of the hospital; an assistant director ready to take charge in the absence of the director; two, at least, associate anæsthetists, and the hospital interne anæsthetists. (Nurses are not legally permitted to practice anæsthesia in our part of Canada.)

The director must be responsible for the training of his staff, maintenance of equipment, assignment of cases, preliminary medication, keeping of records, and the presentation of an annual analytical report

of his department's work. He should restrict his medical practice to the strict specialty of anæsthesia; in many hospitals he also becomes the oxygen-therapy expert. Careful pre-operative categorization of every case as to risk is imperative.

In every community are to be found a few young doctors breaking into practice, with a recent good general internship, who will welcome an appointment in a well organized department of anæsthesia.

Two internes (a senior and a junior) should always be available for anæsthetic duty during the regular operating hours; and two others, mainly on other services, should be available when required.

The anæsthetic chart has three subdivisions, "pre-operative," "operative," and "postoperative." No anæsthetic is allowed to be administered unless the patient has been graded as to anæsthetic and operative risk—and thus we have these notations staring the anæsthetist in the face as soon as he picks up the patient's chart in the operating room. This system, followed only for the past 12 months, has more than justified its institution. The "operative" portion of the chart, filled in by the anæsthetist, gives a "running story" of the anæsthetic and operative period; the "postoperative" portion is the responsibility of the ward or special nurse. Early and often valuable information may be easily made available by having each nurse in charge of a surgical ward send in a weekly return of all postoperative complications on her ward, revealing errors in anæsthetic or surgical technique before further damage is done.

A permanent anæsthetic record book is kept by the senior anæsthetic interne, from which monthly and annual reports are prepared.

Every hospital of any size can operate a good anæsthetic department at no additional cost. The director can be financed in one of two ways: (1) by the hospital collecting and retaining his fees and paying him a salary under contract, with bonus for excess profits; or (2) by the hospital collecting his fees and turning them over to him, with a minimum guarantee by the hospital. Associate anæsthetists are probably best compensated by having their fee added to the patient's hospital bill and transferred to their credit when paid.

THE ORGANIZATION, MANAGEMENT, AND FUNCTIONING OF THE CLINICAL LABORATORY

ROBERT A. GLENN, M.D., Oakland, California: It is with the average sized hospital, of 100 to 150 beds, that the writer's experience has lain. The prime object of the laboratory in these hospitals is a diagnostic service as an aid to clinicians in the study of living patients. Under the State of California laws certification of a clinical laboratory requires that it be under the direction of a physician specializing in clinical pathology, and that for each branch of the work (serology, bacteriology, biochemistry, parasitology, etc.) there must be a technician who has passed a written examination by the Chief of the Division of Laboratories, although one technician may be certified in more than one branch.

Equipment must be sufficiently complete to provide for all well recognized laboratory diagnostic procedures; the fields of bacteriology, biochemistry, serology, parasitology, pathology, as well as all ordinary procedures, must be covered in a dependable manner. Abstruse or complex chemical or biological requests can be submitted to laboratories specializing in such problems.

The clinical laboratory should be located in some conveniently central position in the hospital, and particularly in close association with the surgical pavilion. The pathologist should have an office (be it ever so small and humble) for reflective study, and in which he can comfortably receive clinicians for discussion of cases. He should practice clinical pathology exclusively and devote all his time to that specialty if in private practice as well. The American College of Surgeons has specifically approved the practice of one pathologist dividing his time between two or more reasonably adjacent institutions. The pathologist should have sole charge of the laboratory personnel.

The clinical laboratory should be self-supporting, and should produce an income to the hospital sufficient to cover all reasonable costs of maintenance and development. The laboratory, however, should not be commercialized for the sole purpose of making up deficits incurred in other departments.

There are innumerable plans for laboratory financing, none of which is, perhaps, entirely free from some objectionable feature. It seems to the writer that a laboratory service fee offers a method whereby each patient gets what he pays for, is not charged exorbitantly, and whereby the hospital receives an income sufficient for maintenance and some reasonable profit. The following plan has been in operation for the past 7 years in hospitals over whose laboratories the writer has jurisdiction. It works to the apparent satisfaction of hospitals, clinicians, and, most important, to the patient.

Certain examinations are made for all patients on admission without charge: urinalysis; clotting time of blood in tonsil cases; complete blood count, etc. Patients who stay in the hospital more than 5 days are charged a laboratory service fee of five dollars for each month or fraction thereof they may remain, which covers the entire gamut of diagnostic technique of which the laboratory is capable. A separate charge is made for basal metabolic rates; and diabetic patients are charged fifteen dollars instead of five dollars. Patients remaining less than 5 days, for whom laboratory work is desired, are charged according to the usual fee schedule of the community. Maternity patients are exempt from the laboratory fee, although remaining over 5 days, unless they "go bad," when the five dollar fee, with complete service, is applicable. Thus every patient gets at least what he pays for and, if need be, has available an almost unlimited laboratory service for very little cost. After deducting all charges for salaries, supplies, apparatus, heat, light, gas, rent, depreciation, etc., a hospital may realize a small profit.

CLINICAL AND CLINICOPATHOLOGICAL CONFERENCES

OLIVER W. LOHR, M.D., Saginaw, Michigan: Gross specimens demonstrated at staff conferences do not always show the definite findings that were very evident at the postmortem table because of color changes that take place in the meantime. At the same time it is sometimes difficult to interest even the medical man in bad smelling tissues that have been preserved for some time. Photographs of these specimens, in black and white, made on lantern slides seemed only partially to solve our problem. I tried projecting hand colored plates, but this requires special artistic ability which I do not possess. Then I began making color plates, using lantern slide size Agfa plates. Specimens were photographed as soon as possible after removal from the body, and before being placed in preservative. The gross pathology was presented in this way. The actual specimen was also presented at the meeting. After a time we acquired the technique of making more or less satisfactory color photomicrographs.

We believe that more interest can be stimulated in pathological conferences if the programs are varied. Sometimes the case is presented as an "unknown"; diagnoses are called for, and as the name of the attending physician is not divulged, criticism is free. Sometimes an interesting case is abstracted from the records, minus the operative or pathological findings, and given to one man to work out before the meeting. The final summary proves quite interesting; an incorrect conclusion may be drawn if the abstracting is poor or recordkeeping bad—another reason for keeping accurate records.

PLAN AND SCOPE OF THE RECORD DEPARTMENT

MARY M. NEWTON, Pittsburgh: To build up the record department to its maximum efficiency we must keep pace with the modern educational trend. A record librarian must be capable of meeting other department heads on their own ground. This requires not only practical experience in her department but also a diversified background. I hope that before long a 4 year college course including beside cultural subjects, anatomy, physiology, bacteriology, and symptomatology, as well as library methods, with subsequent practical experience in the hospital, will be required by the Association for registration as a record librarian. Such a course could easily be an adjunct to the university nursing school.

The record room can be made the heart of the institution by having the records of all departments (with the exception of the financial records) gravitate to this center. The function of the department is primarily the filing of the case histories, which can be done by whatever system is best suited to each hospital, but so that any history desired can quickly be produced and that a series of cases of any one disease or condition can easily be procured for study.

The patients' register, the surgical register, and the obstetrical register should properly be kept in the record room, also the monthly departmental reports; and thus this statistical center becomes the logical place for making out all necessary reports. The record of the internes' services and the actual work performed by them can be preserved in this center. The record librarian can assume the responsibility for the completeness of all birth and death certificates, and for promptness in reporting infectious disease cases.

HOSPITAL CANCER RECORDS

PRISCILLA WEIR, New York City: The comments on hospital records which I shall make are based on 3 years' experience in the use of such records for investigation purposes in a representative group of hospitals, and are concerned with general rather than special cancer institutions. I have attempted to outline the main factors in record keeping, aside from actual data included, which produce histories whose analysis will give significant results. These factors are: completeness, accuracy, and organization.

The omission of identification data on various records in the same series will introduce enough variables to minimize the significance of the entire study to an appreciable degree.

If one or more items are incorrectly recorded, the significance of a long time study is affected to an unknown degree. Occasionally such discrepancies are discovered; but there is no way of knowing how many of the less obvious inaccuracies are included in any one series, or of estimating their importance.

The history may contain all the pertinent data with perfect accuracy, but be so poorly organized that locating the items desired is like searching for the needle in the proverbial haystack. The time element involved in abstracting histories is decidedly important.

In perfect record keeping, the human element is made up of two parts: the physician must see that all medical information is present and correct; the librarian must be sure that all the data is included in the patient's record and is well organized for future use.

When it is desired to include in any one study a series of cases from several hospitals, another essential factor is encountered—uniformity. The work of the American College of Surgeons in standardizing hospital records, and in having these standardized forms adopted by an increasing number of hospitals, has been an invaluable aid to the analytical study of case histories.

If an estimate of results is to have real significance, the condition after treatment of the greatest possible number of patients must be known and must be made a component part of case histories. Every cancer patient must be systematically and regularly followed up by means of letter, examination, or contact with private physicians. In this connection, out-patient records can be of great assistance, but they are too often incomplete, inaccurate, and illegible. Out-patient records are as valuable as

house records in such analyses, and it is just as important that they be maintained on a high standard.

THE IMPORTANCE OF ACCURATE AND COMPLETE RECORDS ON FRACTURE CASES

FRANK D. DICKSON, M.D., Kansas City, Missouri: Today fractures are increasing in number and severity to such an extent that their treatment has become a major medical problem. The majority of fractures because of their severity are cared for in the hospital. Whether the fracture case occupies a hospital bed or is cared for in the out-patient department, it is a hospital responsibility and therefore should be of interest to all hospital administrators.

The responsibility of the hospital toward its fracture cases must be discharged along two lines: (1) giving to each fracture case the best treatment obtainable; (2) reducing to a minimum the economic burden which fracture disability places upon the individual, his family, and the hospital. These two purposes are interrelated as only by fulfilling the first can the second be obtained.

Efficient fracture treatment can be secured only through accurate diagnosis, intelligent meeting of the problems encountered, and painstaking supervision in each case. To fulfill these requirements it is necessary that an accurate and complete record of each fracture case be made. Such records are as essential in the fracture case as in any other medical or surgical condition.

The length of hospital stay and period of disability has a direct bearing upon the economic problem which is associated with the majority of fractures. As a rule a wage earner is involved and with the cutting off or reduction of his income the expense incident to treatment becomes a serious matter from a financial point of view. The length of hospital stay and disability period is largely determined by the efficiency of the treatment received which in turn is largely dependent upon the care with which the case is treated and supervised. Accurate and complete records insisted upon is the only feasible method of insuring that each case is cared for in such a way as to secure the most advantageous healing in the shortest possible time, thus reducing the period of hospitalization, the disability period, and making for an enormous saving both socially and economically.

The character of such records will vary in detail in different localities and in different types of hospitals. Such a record, however, should include sufficient data to show the type of fracture, the method of treatment, the period of disability and the end-result in terms of function. In addition, such arrangements for filing the records should be made as will insure that they are at all times easily accessible for study and analysis.